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INDUSTRIAL NOTES..... 400

Reports that the cast iron lining of the St. Clair tunnel was being seriously corroded by the condensation from the locomotive gases have recently been in circulation. We have made inquiry to ascertain the truth of this report and are informed by Chief Engineer Joseph Hobson that so far the locomotive gases have had no appreciable effect on the tunnel lining About a year ago estimates were obtained of the cost of moving the traffic through the tunnel by electricity; but results were not satisfactory and the matter was allowed to drop.

Electric cars for street watering are proposed by the Toronto Street Railway Co., and the company has made an offer to water the 60 miles of streets on which its tracks are laid, four times daily for 65 cts. per mile per day, the city furnishing the water.

A new water supply for the city and county of San Francisco is contemplated and bids are asked until May 22. Bidders must state the location, altitude and extent of the drainage area from which they propose to furnish water, give the average flow for the several months of the year, an analysis of the water, distance from the city, information regarding reservoirs, conduits and supply works in general, estimated cost of from 30,000,000 to 60,000,000 gallons per day, and cost of an adequate distributing system. The official request for proposals states definitely that it is the purpose of the Board of Supervisors to obtain a water supply and to construct or have constructed the necessary works, submitting the scheme to the electors for vote as soon as the cost can be ascertained. Mr. J. A. Russell is Clerk of the Board of Supervisors and Mr. Jas. Denman is chairman of the committee on water supply.

Plans for a gravity water supply for Troy, N. Y., have been approved by the water commissioners, so far as they relate to the taking of water rights and land for reservoirs and a pipe line. Mr. Richard F. Hall has been appointed superintendent of construction.

Further particulars concerning the electrical power transmission plant at Columbia, S. C., illustrated in our last issue, have been furnished to us by the General Electric Co. It appears that the site was such that it was necessary to locate the mill building some 800 ft. distant from the water wheels. Of course a rope drive could have been employed to carry the power over this distance at very small first cost; but it was finally determined to use electric transmission instead and install a separate motor for each department. To insure absolute regularity of speed the three-phase system was adopted and the further advantage was secured of doing away with commutators and avoiding sparking. The turbines generate about 1,000 HP., and are direct-connected to two special slow-speed generators, each of 500 K.-W. capacity, running at 108 revs. per minute and generating a 575-volt current. The armature of the machine is 10 ft. in diameter. The total weight of the machine is about 100,000 lbs. Inside the mill are 17 65-HP. motors placed overhead and driving sections of line shafting by direct belting. The speed of these motors is 535 revs. per minute and the variation in speed from full load to friction load is said to be less than 2%. These machines have neither commutators nor collecting rings and the armature rheostat is operated by a lever from the floor.

The report of the Board of State Engineers of Louisiana on the levee work of the last two years states that the contracts under which the work has been done comprise the building of 254 miles of new levees, and the raising and enlarging 369 miles of old levees two to three feet above highest recorded flood levels, with corresponding increase in section. The earthwork amounted to 25,478,521 cu. yds., at a cost of $4,438,020, including extra prices paid for early completion of important works, the average cost being thus about 17¼ cts. per cu. yd.. About 91 miles of wooden revetment were also built.

A ship canal from Philadelphia across New Jersey to New York bay is projected, and a committee to consider way of carrying it out has been appointed by the Mayor of Philadelphia. The proposed canal is 44 miles long, 11 miles to be through the widened bed of the Delaware & Raritan Canal. It is to be 90 ft. wide at the bottom and 150 ft. at the top, with a summit level of 50 ft. and a draft of 20 ft. The preliminary step in its construction, as called for in a resolution adopted at the meeting on Monday, is the appropriation of $10,000 by the city of Philadelphia for a preliminary survey of the route. A few of the promoters of the scheme are in favor of reviving the old project of a canal directly east across New Jersey to the Atlantic. The majority have many reasons why it should connect with New York by Raritan Bay and Staten Island Sound—practically an inland route. The mouth of the shorter canal would lie in the shifting sands of the Atlantic, and vast expense would be necessary to keep the channel open, and heavy storms might close it for navigation.

The improvement of Riverside Park, New York, is now being carried out, an appropriation of $750,000 having been made for the work. The park is on the west side of the city overlooking the Hudson River. New driveways and walks are being laid out, footbridges will be thrown across the railway tracks to afford access to the boathouses, etc., and it is proposed to build a viaduct to carry the Riverside Drive across the valley from 94th to 98th Sts.

The most serious railway accident of the week was a derailment May 2 on the Florida Central & Peninsular Ry., near Plant City. A trestle gave way under a passenger train, the engine was overturned and three cars were derailed. Three men were injured.

The following bridge accidents have been noted by Mr. C. S. Stowell, of Albany, N. Y.: On April 26, two bridges on the Great Northern Ry. near Fort Buford, were burned.——On April 28, while a party of seven men were crossing a bridge at Cypher, Bedford county, Pa., in a carriage, the structure was blown down. The horse was killed and five of the men badly injured.——On April 23, a highway bridge near Au Gres, Mich., broke down under a carriage containing two persons, one of whom was badly injured.——A span of the Wisconsin & Michigan Ry. bridge, 60 ft. long, near Menominee, Mich., was carried away by a flood, April 24.——A bridge on the Chicago, Burlington & Northern Ry., about 20 miles north of Dubuque, Ia., was washed away May 1.

The shops of the Marietta & North Georgia Ry. at Marietta, Ga., were destroyed by fire May 1. Five engines and several passenger and freight cars were burned.

The Webb Academy and Home for Shipbuilders, founded and endowed by Wm. H. Webb, the veteran shipbuilder, and located at Fordham Heights, New York city, was formally dedicated on Saturday, May 5. The institution at present offers facilities for the education of about 60 boys, who will reside in the building and to whom not only free tuition but free board and lodging will be furnished. The total amount given by Mr. Webb for the erection and endowment of the institution is said to be in excess of $2,000,000. A number of students have already been enrolled, and it is expected that the full capacity of the institution will be taken in the fall. A separate part of the institution constitutes a home for aged and indigent shipbuilders and their wives. The Board of Trustees of the institution consists of Wm. H. Webb, Jas. M. Brown, Chas. L. Smith, Chas. H. Cramp, Richard Poillon, Henry Steers, Prof. W. P. Trowbridge, Andrew Reed, Thos. F. Rowland and Stevenson Taylor.

The Chicago & St. Louis Electric Ry. has been put under construction, 35 men and teams, according to the news dispatches, being at work at Alpine Heights, about 20 miles from Chicago. This force, it is stated, will soon be largely increased. Chief Engineer Hughes is reported as saying that it is the company's intention "to have 24 miles of the Chicago division from Chicago to New Lenox, 5½ miles east of Joliet, in operation as a suburban line by fall. The power house will be at New Lenox. The equipment of rails and ties has already been arranged for, and they will be put in place as soon as the road is graded. We have already 24 miles graded from a point opposite Decatur to Barnett. The company owns 2,000 acres of coal land in the vicinity of Edinburg. We have three propositions under consideration for motors to be guaranteed to run 100 miles an hour. The road bed is to be very fine—rock ballast and 75-lb. steel rails—equal, if not superior, to the Hudson River railroad. We also have three propositions for entering the city. We shall probably choose an elevated road so as to incur the least amount of delay for trains."

The elevation of the tracks of the Chicago, Rock Island & Pacific and Lake Shore & Michigan Southern railways in Chicago, according to the plans of the ordinance passed March 26, 1894, seems likely to be carried out with some modifications notwithstanding the refusal of the companies at first to accept the ordinance. A communication was sent to the city by the railway companies on April 30 in which they asked that the ordinance be made mandatory and all damages to property be assumed by the city, the railways putting up $100,000 to pay them. They also ask that they be allowed to increase the elevation of the track 1 ft. at Archer Ave., 22d St., 31st St., 51st St., 53d St. and Wentworth Ave. and 6 ins. at 35th St. and 47th St., with a corresponding reduction in the depression of the streets, and that the subway at 18th St. be postponed until the elevation of the St. Charles Air Line R. R. One mile of track is to be elevated each year. The approximate amount of work to be done and the conditions of the original ordinance were given in our issue of April 26. The proposition of the railway companies will be submitted to the City Councils Committee on Railways and it is probable that an ordinance will be drafted containing the above modifications and submitted to the City Councils for action.

A Y bridge is reported to be projected at Cincinnati to connect that city with Newport and Covington, on the opposite side of the Ohio. According to newspaper reports the bridge would start from the foot of Broadway in Cincinnati and would extend part way across the river and then divide, one branch leading to Newport and one to Covington, cities located on opposite sides of the Licking River. The bridge would be designed only for rapid transit electric railway tracks.

The latest engineering school to establish a mechanical laboratory is the University of West Virginia, located at Morgantown, on the Baltimore & Ohio. The equipment of the laboratory is now being purchased by Prof. Wm. S. Aldrich, M. Am. Soc. M. E., and will include a storage battery plant, arc and incandescent dynamos and motors, electrical testing and measuring instruments, simple and compound engines, installed so as to work as a triple expansion engine of 100 HP., exhaust steam and independent jet and surface condensers, compound pumping engines for reservoir service and duty tests, and high-pressure sectional boilers, set for coal and natural gas firing. The present equipment of standard engineering testing and measuring instruments and accessories will be materially increased.

The width of any streets laid out hereafter in unimproved sections of Philadelphia is to be 73 ft., and every fifth street is to be 100 ft. wide, according to the provisions of an ordinance now pending before the city councils.

Extensive phosphate deposits have been discovered in eastern Tennessee, in Wayne, Hickman, Lewis and Perry counties, and the usual boom is reported to be rapidly developing. The discoverer of the deposits is said to be Mr. R. W. Childs, of Linden, Perry Co., who is making arrangements for the establishment of fertilizer factories to utilize the product.

THE ANDERSON SYSTEM OF GARBAGE CREMATION.

Among the many ingenious forms of garbage furnaces perhaps the most recent and novel is one recently tested at Chicago, which is an adaptation of the method of burning green brick, other clay bodies, or coke by passing the same on cars through a tunnel-shaped kiln. This style of kiln, and its adaptation to garbage cremation, is the invention of Mr. J. C. Anderson, President of the Anderson Coke, Gas, Power & Reduction Co., 937 The Rookery, Chicago. This company owns the rights for

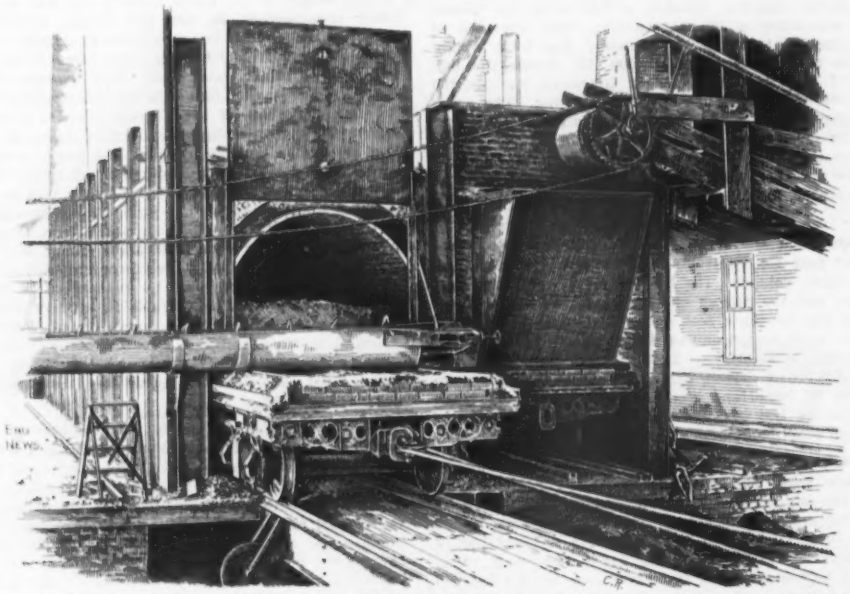


FIG. 1. END VIEW OF ANDERSON GARBAGE FURNACE, SHOWING CONVEYOR REMOVING ASHES FROM CAR.

the system in the United States. A model of the Anderson brick kiln was exhibited by the United States Patent Office at the World's Columbian Exposition, accompanied with a list of the patents upon it (two of March 6, one of March 27, 1888, and six of March 25, 1890), and a brief description, which latter was so brief and clear as to warrant giving it here, as follows:

> This is a continuous kiln, or double tunnel, through which two trains of fireproof cars loaded with green brick to be burned pass in opposite directions, the heat from the burned brick at the outgoing end being transmitted to the green brick in the opposite tunnel in sufficient degree to raise the water smoke and partially burn them before they reach the furnace. The water smoke being decomposed and utilized as hydrogen gas, is drawn forward to the furnace fires located in each of the sidewalls near the center of the tunnel and there burned. Crude oil is generally used for fuel. The fireproofed cars are sealed so as to protect them from the effect of the heat and prevent the ingress of cold air to the burning chamber. Whenever a car of green brick is forced into the tunnel, a car of burned brick is ejected from the opposite end of the same tunnel, and thus the operation of burning may be continued indefinitely without interruption for cooling the product.

In experimenting with the burning of garbage Mr. Anderson employed a tunnel kiln in Chicago which had been used four years for burning fine pressed brick. The necessary changes were made in the kiln to adapt it to its new use and appliances were added for automatically loading and unloading the garbage cars. The following description of the large experimental plant at Chicago is given substantially as sent to us by Mr. J. C. Cushman, Secretary of the Anderson Coke, Gas, Power & Reduction Co.:

A double tunnel, 280 ft. in length, with heavy walls of brick, is shown in end view by Fig. 1 and in side view by Fig. 2, both from photographs. Each tunnel way has double arches overhead, the space between the upper and lower being used for the various flues, by means of which the air currents are regulated, these in turn being connected with brick chimneys or stacks, 127 ft. in height, each tunnel having its own stack. The face of the lower arches and side walls, where the heat is most intense, are lined with the best quality of firebrick.

The outer walls of the tunnel are securely bound with upright buckstays of 80-lb. steel T-rails, 4⅔ ft. c. to c., tied across, over and beneath the walls, with 1½-in. steel rods. The walls are provided with expansion joints.

Through each tunnel a standard gage track of 80-lb. steel rails is laid. The outer walls are perforated at the base with arches, permitting access beneath the cars in the tunnel. Above these for a space of three car lengths openings are made through which the fuel is supplied to the fire, which is burning inside the walls in the upper chamber. The oil used for fuel is forced into the fire by a large volume of compressed air. These openings usually begin at the end of the fourth car length from the entrance of the tunnel and end at the third car length from the outgoing end, which in a ten-car tunnel brings the first fire contact one-half car length beyond the center, allowing that excess for the complete evaporation of moisture.

The inside walls are provided with an iron trough, filled with sand, attached to them the entire length, just below the under surface of the car platform. The width of the tunnel is sufficient to admit the passage of cars when the walls are expanded without impingement, and the tunnel here described holds ten standard size flat cars, each 28 ft. in length. These just fill the space inside the doors which close the entrance when in operation. The bodies of the cars are of steel construction with floors or platforms of firebrick, the platforms being about 8 ins. in thickness and extending at the end so as to come in contact with the platform of the next car when coupled together, thus forming a continuous platform for the entire train.

Beneath the outer edge and attached to both sides of each platform for its full length projects a steel plate about 4 ins. in depth and ¼ in. in thickness. These plates run through sand placed in troughs running the whole length of each side of the tunnel forming a seal which practically divides the tunnel into an upper and lower chamber. The load upon the car passes through the upper chamber and the body of the car beneath the fireproof platform, through the lower chamber.

The trains in the two tunnels always move in opposite directions. At each outer end of the tunnels there is a transfer car provided on its surface with a track that registers with the tracks in the tunnels and it is over the track on these transfer cars that cars are enabled to enter or leave the tunnel. The train is moved through the tunnel by cable, or any other suitable power.

When a fresh car is to be run into the tunnel, it is first placed upon the transfer car and the latter is placed in position to register with the track of the ingoing tunnel. At the same time a transfer car is placed in position to register with the track at the outgoing end, to receive the car that must emerge from the tunnel.

At a signal the door of the outgoing end of the tunnel is hoisted sufficiently to clear the surface of the car platform, the steam power applied to the cable and the train slowly moved. Meantime, at the ingoing end, a car to be loaded has been coupled to the train within the tunnel and as it enters the conveyor and chute, shown in Fig. 1, load the car with 18 to 20 cu. yds. of garbage. At the opposite end the emerging car as it passes beneath the ash conveyor, shown in Fig. 1, has been completely cleaned from the few ashes which remain after passing through the fire, and is at once in readiness to be transferred to the track at the ingoing end of the opposite tunnel, where it receives a fresh load of garbage, and thus immediately starts on its return trip to the opposite end of that tunnel.

Upon its first entrance into the tunnel the fresh load of garbage on the car comes in contact with an atmosphere of about 212° F. Evaporation of moisture at once ensues, which, laden with gases as it arises, is caught up by the air currents and drawn along in the direction the cars are moving, under the arch of the tunnel, until they reach the fire zone, where, in a temperature of about 3,000° F., they mingle with the necessary amount of oxygen to convert them into inflammable gases, and at once ignite and add a large volume of fuel to the flames at this point. As the car progresses in the direction of the fire, the temperature rises rapidly, and the garbage on the car, freed from its moisture, becomes dry and highly inflammable. When in its turn it has reached the fire zone it bursts into

FIG. 2. SIDE VIEW OF ANDERSON GARBAGE FURNACE, SHOWING USE OF AIR POKER.

flame, and the more combustible contents are at once consumed. The ashes, however, exert their tendency to obstruct, but this is met with powerful currents of compressed air mingled with crude petroleum, which bore their way into and through the mass, conveying fresh supplies of oxygen to reinforce the flames. To further overcome the resistance of the ashes, an air poker is used, consisting of an iron pipe, or tube, with sieve-like openings near the end. This tube it attached to a hose connecting it with the air compressor. The operator seizing this tube thrusts it under the contents of the car as it is passing through the fire zone, and the fresh air, forced in under a pressure of 40 to 60 lbs. per sq. in., raises the ashes as if they were struck by a cyclone, scattering their particles in fine dust, in which condition the flame, thus suddenly reinforced by the large volume of oxygen, consumes them before they can settle down again, and cremation is practically complete. During the experiment at Chicago less than 8% of the mass, in the shape of fine ashes, remained after passing through the zone of fire.

Crude petroleum is used freely in the initial firing to raise the heat, but after the required degree is once attained, but little, if any, oil is necessary, as the gases and water utilized are, in fact, more than sufficient to carry on the work of combustion, besides furnishing the requisite steam for operating the power plant. Mr. Anderson estimates the cost of constructing and fully equipping a plant under his methods, with a capacity for cremating 100 cu. yds. per hour, at not over $60,000, exclusive of the land on which it is located.

The tunnel where the late experiments were made developed a speed of about two cars per hour in each tunnel, which could have been materially increased had facilities been provided for handling the cars with greater rapidity. It is estimated that with the conditions of heat attained cars can be passed at the rate of eight per hour through the two tunnels, and the experiments show that no offensive odor is perceptible from the operation.

COMPARATIVE TESTS OF CEMENT BY FLEXURE AND TENSION.

By Edwin J. Morrison.

The following tests are a continuation of the series of comparative transverse and tensile tests of cements made by the writer and Mr. Herman E. Abbott in 1892 and 1893 and published in Engineering News of Dec. 14, 1893.* These additional tests were undertaken at the suggestion of the editors of Engineering News for the purpose of obtaining similar figures for the strengths of cement mortars made with the standard crushed quartz recommended by the committee of the American Society of Civil Engineers, instead of with natural sand sifted to corresponding degrees of fineness. These tests have been made with the original apparatus and were conducted in all particulars like the first tests, with the exception of the use of crushed quartz in place of sand. Three cements were used, viz.: Alsen's Portland and Newark and Hoffman Rosendale. The two first-named cements were fresh, the last had stood about three months in a paper bag and showed signs of deterioration.

The accompanying table contains the record of 283 tests, of which number 87 were tensile tests and 196 transverse tests. The 196 transverse tests were made upon 91 prisms, 79 prisms being first broken at a 4-in. span, and then the longer fragment, and sometimes both fragments, broken at a 2½-in. span. The 79 tests at a 4-in. span gave a value of coefficient C** = 1.54, and 105 tests, all second breaks at a 2½-in. span, gave a value of coefficient C = 1.67, showing an increase of strength in the case of second breaking of about 8%. In the first series of tests it will be remembered that about the same number of tests showed about the same excess of strength in favor of first breaks. The deductions to be drawn from these two sets of experiments (about 400 tests in all) conducted under practically the same conditions, would seem to be that second breaks are just as good as first breaks as an indication of the ultimate strength of cement. This would be an enormous advantage for the transverse method of testing, since from each prism we would get two, and often three, good tests instead of one doubtful one from each briquette broken by tension. The mean value of coefficient C in the following table is about 1.60 and is somewhat lower than the mean value of C obtained in the first series of experiments, as would be expected from the fact that all the tests recorded below were upon quartz mixtures of tender age. Sets 3 and 7 have been marked as doubtful in the following table, because the tests showed less strength at 28 days than at 7 days, but they have been included in the averages, since there was no other reason for discarding them. Both of these sets showed unusually low values of coefficient C. The transverse tests showed 94% good breaks, a little below the average obtained in the first series of tests. The tensile tests made on a Fairbanks machine showed the unusually high average of 92% good breaks.

It was expected that one of the effects of using standard crushed quartz with cement would be shown by a high average strength for specimens carefully prepared; but by comparing the results in the following table with those obtained in the first tests, it appears that the same cements mixed with common sand, sifted to conform to the same degree of fineness as the quartz, show a little greater strength. There was no noticeable increase in the uniformity of breaking.

*Graduating thesis awarded first prize in Engineering News Thesis Competition of 1893.

**Coefficient C represents the actual strength of the prisms tested transversely divided by the theoretical strength which they would have calculated by the common formula ¼ W = 1-6 Rwd² from the average tensile strength of the briquettes in the same set. See Eng. News, Dec. 14, 1893.

TABLE SHOWING RESULTS OF COMPARATIVE TENSILE AND BENDING TESTS OF CEMENT.

Kind of cement.	Proportion by weight. Cement.	Quartz.	Water.	Prisms. (Bending.) No. tested.	Highest.	Lowest.	Average.	P. c. good breaks.	Briquettes (Tension.) Age in days	No. tested.	Highest.	Lowest.	Average.	P. c. good breaks.	Coeff. "C"	Remarks.
Newark	41	41	18	3	10.5	9.	9.5	100	1	5	38	28	34.3	100	1.69	
"	"	"	"	4	18.	12.	15.	100	"						1.67	2½-in. span.**
"	"	"	"	4	30.	16.	19.3	100	7	6	76	39	51.5	100	2.24	
"	"	"	"	4	50.	30.	40.3	100	"						2.87	2½-in. span.**
"	"	"	"	5	35.	23.	29.4	100	28	8	133	87	106.	75	1.67	
"	"	"	"	5	51.	38.	43.	100	"						1.54	2½-in. span.**
"	41	41	18	4	10.5	9.	9.5	75	1	4	36	27	33.	100	1.73	
"	"	"	"	7	18.	8.	13.6	71	"						1.53	2½-in. span.**
"	"	"	"	4	31.	23.	28.	100	7	4	58	49	53.	75	2.00	2½-in. span.**
"	"	"	"	3	38.	24.	31.	100	"						2.20	2½-in. span.**
"	"	"	"	5	29.	19.	24.	60	28	3	125	95	112.	100	1.28	
"	"	"	"	8	56.	32.	45.	75	"						1.50	2½-in. span.**
"	28	58	14	3	5.	3.5	4.2	100	1	4	17	13	14.	100	1.10	2½-in. span.**
"	"	"	"	4	5.5	4.	4.9	100	"						1.25	2½-in. span.**
"	"	"	"	5	10.	5.	8.2	100	8	4	45	35	40.	75	1.26	
"	"	"	"	5	17.	11.	14.5	100	"						1.35	2½-in. span.**
"	"	"	"	5	10.	5.	7.3	80	28	4	42	39	41.	75	1.07	Doubtful.
"	"	"	"	7	14.	8.	11.3	100	"						1.04	2½-in. span.** "
Hoffman	41	41	18	3	4.	2.	3.	100	1	3	13	9	11.3	100	1.58	Cement had stood 3 mos. in a paper bag.
"	"	"	"	5	6.	4.	5.	100	"						1.66	2½-in. span.**
"	"	"	"	4	16.	8.	13.	100	7	3	36	35	35.5	100	1.37	2½-in. span.**
"	"	"	"	4	17.	11.	14.	100	"						1.47	2½-in. span.**
"	"	"	"	5	14.	6.	12.	100	28	4	55	32	41.	100	1.77	
"	"	"	"	8	22.	11.	17.	88	"						1.55	2½-in. span.**
Alsen's	43½	43½	13	4	7.	4.5	5.8	100	1	3	38	27	32.	100	1.10	Prisms kept in molds 8 hrs lngr than briquettes
"	"	"	"	8	12.	6.	10.	100	"						1.40	2½-in. span.**
"	"	"	"	3	53.	49.	51.	100	7	4	185	130	158.	100	1.90	
"	"	"	"	3	105.	89.	94.	100	"						2.20	2½-in. span.**
"	"	"	"	5	75.	64.	72.	100	28	4	233	190	205.	100	2.12	
"	"	"	"	6	180.	110.	142.	100	"						2.60	2½-in. span.**
"	30	60	10	6	7.5	3.	5.	100	1	7	26	10	16.	86	1.19	2½-in. span.**
"	"	"	"	4	25.	22.	24.5	100	7	2	90	78	84.	100	1.80	
"	"	"	"	4	46.	30.	36.5	100	"						1.60	2½-in. span.**
"	"	"	"	4	40.	23.	31.	100	28	3	140	120	131.	100	1.41	
"	"	"	"	8	75.	54.	61.3	75	"						1.76	2½-in. span.**
"	43	43	14	6	12.	5.5	10.6	100	1	4	32	25	29.	100	1.38	
"	"	"	"	4	26.	21.	24.	100	7	4	176	117	138.	100	1.05	
"	"	"	"	4	54.	40.	51.	100	"						1.50	2½-in. span.**
"	"	"	"	5	29.	22.	25.6	100	28	4	170	126	148.	75	1.04	Doubtful.
"	"	"	"	8	55.	33.	43.	100	"						1.09	2½-in. span.** "
				196						87						

** Denotes second breaks of prisms. Temperature of room, 56° F.; temperature of water 50° F.

CABLEWAYS AND CANTILEVERS ON THE CHICAGO DRAINAGE CANAL.

The rivalry still continues between the cableway and the cantilever in handling the rock on the line of the Chicago drainage canal, as described in our issue of June 1, 1893, in connection with an illustrated description of this work. When taking out the first "lift," the cantilever had much advantage, for the rock broke up in small pieces, convenient for loading into the skips. The capacity of the cantilever skips is from 7,000 to 10,000 lbs., and, as stated in our illustrated description of the machine (Eng. News, Oct. 5, 1893), the Brown Hoisting & Conveying Machine Co., builders of the cantilevers, guarantee a capacity of 25 trips per hour, or 88 tons. The company informs us, however, that the cantilever has recorded an average of 43.8 trips per hour for an entire day (438 loads in a day of 10 hours) and has made 9 trips in 12½ minutes.

This 438 loads (averaging 1¾ cu. yds. of rock in place per load), which now stands as the best record for a day's work of a cantilever, is equivalent to 1,550 tons, or about 766 cu. yds. of rock in place. During the month of February a cantilever working on the second lift moved 6,379 loads, working on 21 days, or a total of 186 hours, an average for the whole month of 34.3 loads per hour.

The Brown Hoisting & Conveying Machine Co. has now 11 cantilevers at work along the line of the canal, of which 3 were sold outright and 8 are operated by the company moving rock under contract with the contractors at 15 cts. per cu. yd. The price of the cantilever is about $28,000.

One cableway in February moved 4,407 loads (averaging 2⅛ cu. yds. of rock in place per load) in 21 days, working on the second lift, and we are informed by the Lidgerwood Mfg. Co., builders of the cableways, that a daily output of 1,094 tons has recently been recorded by a cableway; the daily average, however, seems to be about 1,000 tons, or about 500 cu. yds. of rock in place.

In comparing these figures for output, it is fair to say that the cantilever has had somewhat of an advantage in making records, as a choice could be made between the 11 cantilevers at work, while up to the present time only three cableways are at work on the canal, one of which is working in earth. Recently, however, eight new cableways have been ordered by contractors on the canal, four by Mr. C. H. Locher and four by the Des Plaines Construction Co. The new cableways will have a greater span and heavier cable than those now at work, and are expected to show a larger output. The price of a cableway is something less than $14,000.

Since work began on the second and third lifts the character of the rock has materially changed, and it now breaks up in large blocks. Under these conditions the cableway works with a certain advantage, for these large pieces, which could not be loaded into skips without reblasting, can be handled by a sling from the cableway, and need be hoisted only high enough to clear the edge of the cut and reach the desired position on the spoil bank. With the cantilever, rock can be handled by hooks or chains, but it is not done on account of the possibility of the load

falling through insecure fastening. It will be remembered that the cantilever lifts the load from the pit, carries it over the roof of the engine house and deposits it on the spoil bank. Secure fastening of the load, therefore, is important. With the cableway the entire space traversed by the fall block is clear; hence large blocks can be handled without loading into skips without danger to the men below.

To prevent any injustice to either of the firms interested we have submitted proofs of the above article to each of them with an invitation to each to present such criticisms or additional matter as they choose. The letters received in reply are appended.

Sir: Your article on "Cableways and Cantilevers on the Chicago Drainage Canal" was submitted to this company. As the article in certain parts would lead to a wrong conclusion, the following information is given: This company has built many cableways, and when the problem of handling rock on the canal was presented, where a machine was required that could be easily and rapidly moved along the berme to avoid blasts and to follow the work, the cableway was at once discarded as not suitable to the requirements and the cantilever was designed. The first plan was for a machine to handle 1,000 cu. yds. of rock in place in a day of 10 hours; but this capacity was cut down, because the contractors decided that it was impossible to work sufficient men on a face to loosen rock and fill buckets for so large a quantity. The guarantee of 250 loads per day was then given, which was satisfactory to the purchasers.

Our buckets have a capacity of 75 cu. ft. even full, equivalent to 1.75 cu. yds. of solid rock in place—about 3½ tons. The weight of the limestone where the cantilevers are at work is 150 lbs. per cu. ft. The bucket load in working varies more or less, according to the fragments of rock and manner of filling by the workmen, occasionally with heaped buckets loads exceed 4½ tons—we try to maintain an average of 3½ tons. Large pieces of rock can be handled by hooks and chain, but actual trial has proved that it takes more time and is more expensive to the contractor to fasten on a large piece, run it out and disengage it, than to move a larger quantity in buckets that are self-dumping. With the eight cantilevers under our control rock is handled only in buckets, because the contractors will not take the responsibility of injury to workmen or machines by falling pieces.

In regard to quality of rock in the third lift the reports of work done show an increase of quantity handled over that in the first lift. During the first half of April two cantilevers working on third lift, designated as No. 4 and No. 6, gave the following results:

No. 4—3,937 loads in 112 hours.
No. 6—3,963 " " 105 "

This is about 123 tons per hour for No. 4 and 132 tons per hour for No. 6.

The only cableway working in rock of which we have definite knowledge is on Section 11, where two of our cantilevers are at work. We receive daily reports of the number of loads and a copy of the engineer's monthly estimate. The engineer's estimate for the cableway for February is 7,600 cu. yds. This is evidently not the one referred to in your article. Any one interested in the subject should visit the canal sections where the cableways are working in rock and note the number of men required to operate and move the respective machines and the quality of workmanship and material in their construction. Very truly yours,

The Brown Hoisting & Conveying Machine Co.,
By E. T. Scovill, Secretary.

Cleveland, O., April 26, 1894.

Sir: We have to thank you for submitting to us for correction the proof of your article entitled "Cableways and Cantilevers on the Chicago Drainage Canal." It would give us great pleasure to add some further positive information, were it possible for us to obtain it at the present time.

We feel that the reason of our receiving the recent contract for eight more of our traveling cableways for the Chicago Drainage Canal lies in the fact that the cableway has demonstrated itself to be the most economical hoisting and conveying device on the drainage canal.

The strongest claims for the cableway are that it appears to save in the labor of loading the skips over the cantilever an amount, we are informed, somewhat in excess of 3 cts. per cu. yd. It is to be observed that when the cableway and cantilever are working under the same conditions, and handling about the same yardage, that 32 men are employed under the cableway, while from 40 to 42 are employed under the cantilever.

One of the contractors, Mr. C. H. Locher, who is using one cantilever and one cableway, and who has ordered four more cableways, has found that the saving in powder for blasting amounts to 1¼ cts. per cu. yd. This is because the cableway is capable of handling large blocks, while with the cantilever it is not safe to do so, as stated by you in your article.

When the new cableways are erected and have operated long enough to get a record, we would be pleased to send to your valuable paper definite data in this regard. The new cableways will be run at a higher rate of speed than the old ones, and will be capable of handling 8-ton blocks in place of 6-ton. There will be other improvements, which are expected to further assist in the increase of capacity.

The total apparent saving of the cableway over the cantilever at the present time is about 4½ cts. per cu. yd., which we expect will be considerably increased with the new machines. As the case stands at present a $14,000 traveling cableway has about the same capacity as a $28,000 cantilever, and apparently effects a saving of 4½ cts. per yard for every yard conveyed. As we are informed that the cantilever contracts are for 200,000 cu. yds. for each machine, the saving would be, say, $9,000 on yardage and $14,000 on purchase price, or $23,000; and as four machines are generally used on a section, this would amount to $92,000 on each section.

Yours truly, Lidgerwood Mfg. Co.
Dictated by Spencer Miller.

New York, April 23, 1894.

T-RAILS AND SPIRAL CURVES ON THE DENVER STREET RAILWAYS.

The wonderful growth of the electric railway for suburban traffic facilities is perhaps not generally

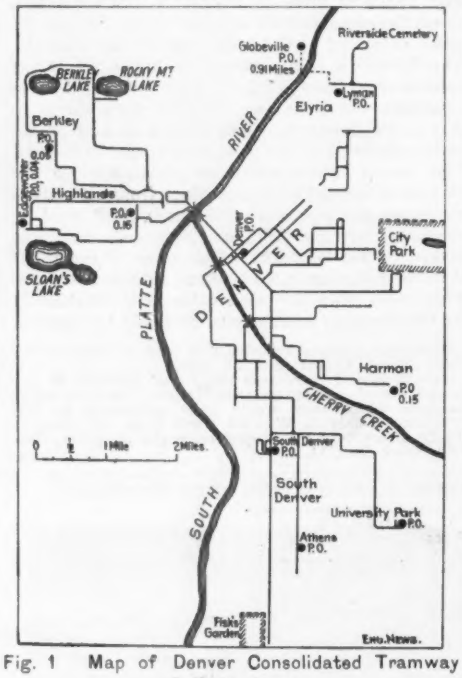


Fig. 1 Map of Denver Consolidated Tramway Co.'s System.

recognized, but an instance of this is afforded by the city of Denver, Colo., where the Denver Consolidated Tramway Co. is now operating a system of 100 miles of electric street railway, including some 175 crossings (many of which are steam railway crossings), 325 switches and 375 curves. The accompanying map of this system, Fig. 1, shows that it touches no less than ten postoffices. The track is laid entirely with T-rails, many miles of which are in paved streets, and this track is found to be very smooth and to require but little expense for maintenance. The form of rail used is 6 ins. high and 5 ins. base, weighing 72 lbs. per yd., and, together with the track construction, was illustrated in our issue of Sept. 21, 1893.

The curves are all "spiraled" with a system of "graduated" guards, introduced by Mr. John A. Beeler, constructing engineer of the company, to whom we are indebted for these particulars. A speed of 15 to 18 miles per hour may be maintained around a 45-ft. radius curve without causing the usual unpleasant bumping or lurching motion of the car, nor is there any danger of leaving the track. They make a very smooth riding track. Three men have been keeping all the switches, curves and crossings in good repair during six months. During this time not a single car has been derailed or delayed on account of curves, crossings or switches.

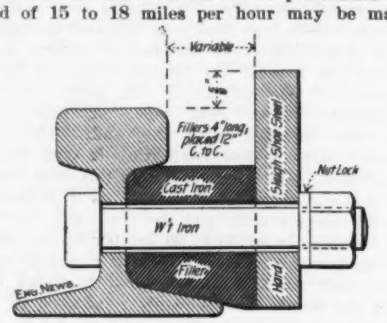


Fig. 3. Guard Rail for Curves, Denver Electric Railway.

On curves from 35 to 75 ft. radius a spiral approach of 18 ft. is used at both ends, as shown in Fig. 2, which is a diagram illustrating a 53-ft. curve. At the point of spiral curve (P. S. C.), the radius equals infinity, thence decreasing until it corresponds with the given radius of the central or regular curve, whatever that may be, (as 53 ft. in the diagram). This point of junction, where the radius of the spiral coincides with the radius of the central curve, is the point of central curve (P. C. C.), thence the given radius is continued to the center of the curve. The other half of the curve being the same when commencing at the point of spiral tangent (P. S. T.), which equals P. S. C., and running to the center in the same manner.

The graduated guard is a piece of flat sleigh-shoe steel bolted to the rail at intervals of 12 ins. and separated from the rail by means of cast iron fillers, Fig. 3, cast in varying thicknesses and placed as shown in Fig. 1. On the straight track before reaching the P. S. C., the space between the rail and guard is 1 1-4 ins.; then gradually increasing by the use of wider fillers to 1 5-16 ins., 1 3-8 ins. and 1 7-16 ins., until 1 1-2 ins. space is reached, which continues to the center of the curve. From the other end of the curve the same mode of spacing is repeated. The gage of the track also varies as shown upon the diagram.

On a curve of a shorter or longer radius than 53 ft., the fillers may be placed accordingly. This is one of the advantages of this style of guard, it may be placed just exactly where it is wanted, and is not a fixed distance from the gage line, irrespective of the radius, which at best is only approximately right, consequently it does not wear out like a grooved girder rail. The fact that it is placed in its proper position with regard to the wheel, insures it from being destroyed by undue wear at any one point, while with a grooved girder rail such wear renders the whole rail useless and it is consigned bodily to the scrap pile. When this guard is worn out it may be taken off, reversed and rebolted to the running rail and the track is again as good as new at comparatively no expense. With proper elevation of the outer rail, a very high rate of speed may be maintained around these curves without the least unpleasant bumping or lurching motion of the car.

FIG. 2. PLAN OF SPIRALED CURVE, DENVER ELECTRIC RAILWAY.

TWO-CYLINDER COMPOUND FREIGHT LOCOMOTIVE; C., C., C. & ST. L. RY.

The practical advantages which have been clearly proved to result from the use of the compound system for locomotives, and the consequent extensive adoption of the system, have naturally led the locomotive building companies to take the matter up, and most of the leading companies now control patents covering special details of construction. The Richmond Locomotive & Machine Works, of Richmond, Va., have built two ten-wheel freight engines fitted with their patent system of compounding, covering the intercepting valve and regulating mechanism, and one of these is illustrated in the accompanying cut, which shows the engine fitted with appliances for taking indicator cards during the trials. The engine has a separate exhaust for each cylinder, so that it can be worked simple when required, as in case of a breakdown on either side, or for pulling a heavy train over a short steep grade, or for starting a heavy train more quickly than it could be done with the automatic action of the valve. In working simple, the pressure of live steam in the low-pressure cylinder is controlled by an automatic regulating valve, and cannot exceed half the boiler pressure.

The first of these engines has been in use on the Chesapeake & Ohio Ry. for about 15 months, and Mr. Morris, Superintendent of Motive Power, states that it shows a saving in coal, as compared with the average of all the simple engines, of between 15 and 16%. No account has been kept of the water evaporation. In a series of tests with three engines of the same class made on the James River Division, between Richmond and Gladstone, 119 miles, the results were as follows, the engines being given the best attention and showing better results than in ordinary daily work:

	Ave. no. of cars.	Coal per car-mile.
Simple, No. 112, straight stack, old standard exhaust	37.5	2.95 lbs.
Simple, No. 125, taper stack, new standard exhaust	37.5	2.89 "
Compound, No. 140	36.6	2.74 "

From the locomotive performance record of the James River Division for the year 1893, for which we are indebted to Mr. Morris, we have prepared the following table showing the comparative results of the compound engine No. 140 and ten simple engines also built by the Richmond Locomotive Works and all eleven engines being exactly alike except as to the cylinders, the simple engines having cylinders 19 × 24 ins., and the compound engine No. 140 having a high-pressure cylinder 19 × 24 ins. and a low-pressure cylinder 29 × 24 ins. All the engines carry the same boiler pressure and have the same size boilers. It will be seen that the compound engine made 44,054 miles against an average of 38,906 miles by the other engines and cost $710.90 for repairs, while the average cost of the other engines was $883.32. The total expense of the compound engine was $5,028.90, while the average total expense for the other engines was $5,340.46. Comparing the cost per mile run in cents, the cost of repairs for the compound was 1.61 cts., and the average for the other engines was 2.27 cts.; the cost of oil and waste for the compound was 0.21 ct. and 0.27 ct. for the other engines; the fuel cost 3.71 cts., for the compound and 5.02 cts. for the other engines, so that the total cost per mile run was 11.42 cts. for the compound, against 13.73 cts. for the average of the simple engines.

Locomotive Performance Record, 1893.
James River Division, C. & O. Ry.

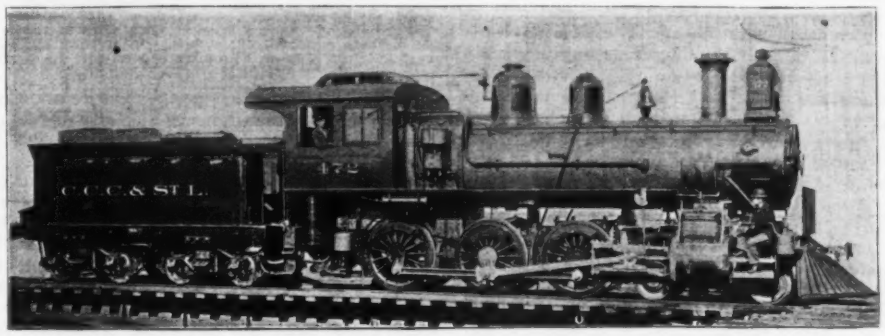
	Simple. (average.)	Compound.
Mileage.		
Passenger	1,514	53
Freight	35,382	41,565
Switching	1,930	2,179
Work trains	79	252
Total miles	38,906	44,054
Repairs.		
Labor	$668.21	$557.40
Materials	215.11	153.50
Total cost	883.32	710.90
Oil and waste consumed.		
Burning oil, pints	832	1,011
Lubricating oil, pints	2,283	1,709
Waste, lbs	204	252
Total cost	$101.88	$95.72
Fuel consumed		
Coal, tons	2,557	2,153
Wood, cords	11	1⅝
Total cost	$1,953.16	$1,632.59
Wages of enginmen and firemen	2,324.66	2,507.54
Cost of cleaning and watching	77.36	84.15
Total expense of engine	5,340.46	5,028.90
Miles run per pint of oil	17.04	24.41
" " " lb. of coal	15.22	20.46
Cost per mile run (cents.)		
Repairs	2.27	1.61
Oil and waste	0.27	0.21
Enginemen and firemen	5.97	5.70
Fuel	5.02	3.71
Cleaning and watching	0.20	0.19
Total	13.73	11.42
Cars hauled one mile.		
Passenger cars	4,586	2,901
Freight cars equal to loaded cars	1,277,886	1,459,546
Average No. per passenger train	3	5
Average No. per freight train	36	35

The second engine, built for the Cleveland, Cincinnati, Chicago & St. Louis Ry., has not been in regular service much, but has been used on various divisions in order to enable the builders to exhibit the engine to the mechanical men in charge of connecting roads, but will be given a practical service test after it is put in regular service. Mr. Garstang, Superintendent of Motive Power, sends a statement comparing the performance, for the month of December, 1893, of 16 ten-wheel simple freight engines and the compound engine, which is of identical construction except in the compounding arrangements. From this statement we take the following table:

	Ave. of 16 Simple.	Compound.
Engine miles, freight	2,844	1,123
Miles per ton of coal	16.91	24.00
Miles per pint of oil	10.06	6.05
Coal per engine mile, lbs.	118.27	85.33
Average number of cars per train	22.4	26.1
Average number of cars hauled 1 mile per ton of coal	379.0	568.8
Coal per car-mile, lbs.	5.29	3.52
Steam pressure, lbs.	180	180

Several trial runs were made in February between Chicago and Kankakee, 55¾ miles, on the Illinois Central R. R., and on one of these trips the engine hauled a train of 48 cars, weighing 1,660 tons, from Kankakee to Chicago, working simple at starting, on an ascending grade of 15 ft. per mile for half a mile, followed by one 29 ft. half a mile long, and a third of 24 ft. per mile, two miles long. The engine burns bituminous coal. We are indebted to the builders for the following list of dimensions, which is given in our standard tabular form:

Running Gear.	
Driving wheels, diam.	4 ft. 8 ins.
Truck " "	2 " 4 "
Tender " "	2 " 9 "
Engine truck	Radial center
Journals, driving axles	8 × 9½ ins.
" truck axles	5¾ × 10 "
" tender axles	4¼ × 8 "
Wheel Base.—Driving	11 ft. 10 ins.
Truck	6 " 7 "
Total engine	23 " 0½ "
" tender	15 " 0 "
" engine and tender	48 " 8½ "
Center of truck pin to center of leading driver	7 " 8 "
Driving wheels having blind tires	First pair.
Weight in Working Order.	
On driving wheels	107,000 lbs.
On truck wheels	29,000 "
Engine, total	136,000 "
Cylinder, h. p.	19 × 24 ins.
" l. p.	30 × 24 "
Ratio of area of h. p. to l. p.	1 to 2.45 "
Distance, center to center	7 ft. 4 ins.
" center to valve face, h.p., 17 ins.; l.p. 21	"
Piston rod, diam.	3⅜ "
Form crosshead and guides, Penn.R.R., 2-bar guides.	
Connecting rod, length between centers	9 ft. 1 in.
Valve Gear	Richardson balanced valve.
Ports; steam	h.p., 1¼ × 23 ins.; l.p., 1⅝ × 23 ins.
" exhaust	h.p., 2½ × 23 ins.; l.p., 3¼ × 24 ins.
Slide valves	lap ⅞ in.; max. travel, 5½ "
" " leading	h.p., 5-16 in.; l.p., 1-16 in.
Boiler.—Type	Belpaire.
Diam. of barrel inside	4 ft. 10⅝ ins.
Thickness of barrel plates	9-16 in.
Thickness of smokebox tube plate	½ in.
Height from rail to center line	7 ft. 11½ ins.
Length of smokebox	6 " 0 "
Working steam pressure	180 lbs.
Firebox.—On top of frames, sloping forward.	
Length inside	8 ft. 11 13-16 ins.
Width inside	3 ft. 5⅞ "
Depth at front	5 " [illegible] "
Depth of back	5 " 1⅜ "
Thickness of side and back plates	⅜ in.
" crown sheet	⅜ "
" tube sheet	½ "
Grate area	31.5 sq. ft.
Staybolts, diam. ⅞ in.; pitch, 4⅜ ins.	
Water space, width, front and back	4 "
" " " sides	3½ "
Tubes.—Number, 241; pitch	2¾ "
Diam. outside	2 "
Length between tube plates	13 ft. 9 13-16 "
Heating Surface.	
Tubes, exterior	1,750 sq. ft.
Firebox	155 "
Total with exterior tube area	1,905 "
Miscellaneous.	
Exhaust nozzle, diam.	5 ins.
Smokestack, smallest diam.	1 ft. 6 "
Smokestack, height from rail to top	14 " 5 "
Capacity of tank	4,000 gallons.
Brake fittings	New York air brake.



TWO-CYLINDER COMPOUND FREIGHT LOCOMOTIVE; C., C., C. & ST. L. RY.
Builders, Richmond Locomotive & Machine Works.

NOTES ON THE GREAT KANAWHA IMPROVEMENT AND THE CHANOINE WICKET DAMS.*

By Addison M. Scott.

This paper was largely a discussion on the paper presented by F. Guillian on navigation works in France, presented at the Engineering Congress. The Pasquean hurter was first used in America in the Chanoine dams on the Great Kanawha. The complete improvement will consist of ten locks and dams, carrying the slack water for a distance of 90½ miles up the river from its mouth. The two upper dams of the system are fixed; the others are movable, and are kept up only at the low stage of water. The improvement is mainly for coal commerce, which is done in barges of about 25 × 130 ft., with a draft of 6½ ft., and capacity of 500 tons. The minimum low water depth, therefore, on the sills of the locks is 7 ft.

Dams 4 and 5 were put in operation in 1880, and were the first movable dams for slack water improvement in America. Five others, three movable and two fixed, have been built since, and three more are now under construction. All are of the Chanoine wicket type, operated from service bridges. The pass wickets are 3 ft. 8 ins. wide and 13 ft. 5½ ins. to 14 ft. 1 in. long. These are the largest ever built, with the exception of those at the La Mulatiere dam at Lyons, France. At the navigable passses, dams 4 and 5, the tripping bars are operated by gearing wells in the lock wall, and a center pier, on the regular Chanoine plan. The bar operated from the lock tripped 34 wickets, and is 141 ft. long. The bar from the center pier is 119 ft. long, and tripped 28 wickets. When the bars worked well they were very satisfactory, as the dam could be easily and rapidly lowered, but a great deal of trouble was had from the first. It was found that both bars and gearing were too light for such a wide passage, the bars became clogged more or less with water-soaked sticks, gravel, etc., and when clogged the gearing was not strong enough to pull the bars in, and they were sometimes buckled and broken in being pushed back to place. From lack of proper provision the bars were frequently found off the track when the dam was to be raised. On account of this trouble, the writer recommended in June, 1881, a trial of the Pasqueau hurters with a view of adopting them and eliminating the tripping bars altogetner. These were tried on lock 5, and were entirely successful. In making the changes the Chanoine hurters were removed, and the new hurters placed by divers, without a cofferdam. No change was made in the "slides." The short bars, tripping 14 to 15 wickets, at dams 4 "

* Abstract (from the Society's bulletin) of a paper read before the American Society of Civil Engineers, May 2.

and 5, have caused little trouble, and have been retained, as there is some advantage in their use in lowering.

While the decided superiority of the Pasqueau principle has been thoroughly established, experience has shown that it will be practicable to operate a 250-ft. pass, or one somewhat wider, with properly constructed tripping bars, the difference in cost being slight. While the dam can be lowered faster and easier with the bars, the difference in time is not enough to be material. The 62 wickets on one of the Great Kanawha passes, fitted entirely with automatic hurters, are lowered usually in about 45 minutes; with tripping bars they could be lowered in about 15 minutes.

The great advantage of the Pasqueau principle is in time and labor saved in raising the dam. It is necessary by the other system to examine and clear the gearing wells throughout before raising, and this work must be done by divers. The first raising in the spring of dams 4 and 5 usually requires three or four days, and, after that, from one to two days are generally required. With the improved hurters this is all avoided, and the dam can be put up quicker and easier, and at a higher stage of water, than with the bars. It seems safe to say, therefore, that the day of tripping bars on new Chanoine dams is passed, save possibly in short lengths, and in exceptional cases, where rapid lowering is of great importance.

The experience with movable dams on this river has been very satisfactory, they are easily and rapidly manoeuvred, the expense of operation and maintenance is but little more than with fixed dams, and they are highly satisfactory to the river interests. They are kept up only when the stage of water requires it, and they furnish all the advantages of fixed dams, without their drawbacks. In fixed dams everything must pass through the locks, and navigation is entirely suspended when the river is near or above the top of the lock walls. With movable dams the locks are only used when the discharge is so small as to make them necessary. At other times they are at the bottom of the river, and afford no obstruction to navigation. This is particularly an advantage in the case of coal barges, which go in fleets. There is considerable advantage also from the less difficulty in protecting the bank from scour about the works.

A SIMPLE HYDRAULIC FORMULA FOR WATER POWER COMPUTATION.

By William Cox.

The amount of friction caused by the flow of water in pipes, and the consequent velocity of discharge, are dependent upon a variety of conditions, the value of each one having been variously estimated by the different hydraulic engineers who have attacked the subject. The late Mr. P. J. Flynn, M. Am. Soc. C. E., in his able work on "Irrigation Canals," tabulates no less than 37 different formulas which have been offered as giving correct results. Many of these are, as might be expected, applicable only to a limited number of special conditions, while a few are said by their authors to be of almost general application. When the various conditions of head, length of pipe, wetted perimeter and cleanness or foulness of the inner surface of the pipe are taken into consideration it is not to be wondered at that the many different experiments made with a view of clearing the subject of all uncertainty, should have led, when tabulated, to such different results.

In this country, among builders of machinery for water power purposes, Weisbach's formula has been very generally adopted, and has, so far as the writer knows, been generally found satisfactory. It is as follows, F denoting friction head:

$$F = \left(0.0144 + \frac{0.01716}{\sqrt{V}} \right) \frac{L.\ V^2}{5.367 d}$$

where L = length of pipe in feet,
V = real velocity of the water in feet per second,
d = diameter of pipe in inches.

The following original formula gives almost identical results, while it has the advantage of exceeding simplicity,

$$F = \frac{L}{1200 d} \times (4\ V^2 + 5\ V - 2) \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

From this we obtain by transposition

$$4\ V^2 + 5\ V - 2 = \frac{d \times F \times 1200}{L} \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Putting the value of

$$\frac{d \times F \times 1200}{L} = K,$$

we have

$$4\ V^2 + 5\ V - 2 = K,$$

whence we obtain the real velocity by

$$V = \frac{\sqrt{16\ K + 57} - 5}{8}.$$

In Engineering News of Dec. 22, 1892, in connection with an article relating to Cox's pipe computer, the above formula for friction head was published, and by way of simplification, it was reduced to the form

$$H = \frac{L \times C}{D}$$

in which C was a variable for which the ten values were given corresponding to velocities of from 1 to 10. In place of C I now use K, as given above, and have computed its value to tenths of feet for velocities of from 1 to 20 ft. These values are given in the accompanying table. Intermediate values may be determined by interpolation:

Values of $K = 4\ V^2 + 5\ V - 2$ for Velocities of from 1 to 20, by Tenths of Feet.

V	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	V
1.0	7.00	8.34	9.76	11.26	12.84	14.50	16.24	18.06	19.96	21.94	1.0
2.0	24.00	26.14	28.36	30.66	33.04	35.50	38.04	40.66	43.36	46.14	2.0
3.0	49.00	51.94	54.96	58.06	61.24	64.50	67.84	71.26	74.76	78.34	3.0
4.0	82.00	85.74	89.56	93.46	97.44	101.50	105.64	109.86	114.16	118.54	4.0
5.0	123.00	127.54	132.16	136.86	141.64	146.50	151.44	156.46	161.56	166.74	5.0
6.0	172.00	177.34	182.76	188.26	193.84	199.50	205.24	211.06	216.96	222.94	6.0
7.0	229.00	235.14	241.36	247.66	254.04	260.50	267.04	273.66	280.36	287.14	7.0
8.0	294.00	300.94	307.96	315.06	322.24	329.50	336.84	344.26	351.76	359.34	8.0
9.0	367.00	374.74	382.56	390.46	398.44	406.50	414.64	422.86	431.16	439.54	9.0
10.0	448.00	456.54	465.16	473.86	482.64	491.50	500.44	509.46	518.56	527.74	10.0
11.0	537.00	546.34	555.76	565.26	574.84	584.50	594.24	604.06	613.96	623.94	11.0
12.0	634.00	644.14	654.36	664.66	675.04	685.50	696.04	706.66	717.36	728.14	12.0
13.0	739.00	749.94	760.96	772.06	783.24	794.50	805.84	817.26	828.76	840.34	13.0
14.0	852.00	863.74	875.56	887.46	899.44	911.50	923.64	935.86	948.16	960.54	14.0
15.0	973.00	985.54	998.16	1,010.86	1,023.64	1,036.50	1,049.44	1,062.46	1,075.56	1,088.74	15.0
16.0	1,102.00	1,115.34	1,128.76	1,142.26	1,155.84	1,169.50	1,183.24	1,197.06	1,210.96	1,224.94	16.0
17.0	1,239.00	1,253.14	1,267.36	1,281.66	1,296.04	1,310.50	1,325.04	1,339.66	1,354.36	1,369.14	17.0
18.0	1,384.00	1,398.94	1,413.96	1,429.06	1,444.24	1,459.50	1,474.84	1,490.26	1,505.76	1,521.34	18.0
19.0	1,537.00	1,552.74	1,568.56	1,584.46	1,600.44	1,616.50	1,632.64	1,648.86	1,665.16	1,681.54	19.0
20.0	1,698.00	1,714.54	1,731.16	1,747.86	1,764.64	1,781.50	1,798.44	1,815.46	1,832.56	1,849.74	20.0

AMENDMENTS TO THE INTERCHANGE RULES.

In accordance with the annual custom the various railway clubs at their April meetings discussed proposed amendments to the rules governing the condition and repair of freight cars in the interchange of traffic. The following is the substance of the changes proposed at the meetings of the Western, Central and New York clubs:

Size of Axles.—The New York Club wants the limit in the size of wheel seat for axles on a 30,000-lb. car to be made 4½ ins. and the center diameter to be 3¾ ins. These dimensions have not heretofore been specified on this size of axle. On cars of 20,000 lbs. capacity the Western, New York and Central clubs want the limit in size of journal to be raised to 3 ins. from the present 2¾ ins. The New York Club would also establish 4¾ ins. for the wheel seat and 3¾ ins. for the center on this size of axle.

Gage of Wheels.—This topic, which is doubtless one of the most important which will be brought before the Association this year, seems to be hardly understood as yet by the members. The New York and Central clubs make no recommendation. The Western Club recommends that the rule which now specifies that the gage between backs of flanges shall be not more than 4 ft. 5¾ ins. or less than 4 ft. 5 ins., be changed to read not more than 4 ft. 5⅝ ins., or less than 4 ft. 5⅛ ins. For explanation of the matter at issue see papers by G. W. Rhodes (Eng. News, Feb. 2, 1893), and A. A. Schenck (Eng. News, April 19, 1894).

Oiling Brake Cylinders.—The rules now specify that the brake cylinder of an air-braked car must have been oiled within three months and the date of oiling marked on the cylinder. The New York Club would raise this to six months and the Central Club to twelve months.

Defects of Couplers.—The Western Club's committee proposed to omit the entire set of rules specifying what shall constitute "bad order" with reference to drawbars, draw gear and their fastenings. The proposition was voted down. The Central Club, on the other hand, proposes to add to these rules limits for the length of crack admissible in the fillet of the shank of the coupler and in its front wall or face.

Steps and Grab Irons.—The New York Club wants these to be fastened with iron lag screws at least ½ in. in diameter.

Door Fastenings.—The New York Club wants authority to refuse cars with doors having improper fastenings.

Center Plates.—The Western Club's committee proposed to omit part of the specifications as to defects of center plates, and it was so adopted that the rule requires merely that center plates must have two effective bolts unless fitted with long center pin.

Oil Box Cover.—The New York Club would require the acceptance of an M. C. B. Std. oil box with any M. C. B. cover without considering a cover different from the one originally fitted a defect.

Indelible Pencil.—Both the New York and the Central clubs would forbid further use of indelible pencils in making out defect cards.

Partial Repairs of Car with Defect Card.—The Central Club wants the following clause added to Rule 6, which permits the passage of a car with defects which render it unsafe to run, provided a defect card is attached:

When partial repairs are found necessary for the safe running of a car carded with an M. C. B. defect card, they may be made and company carding car advised, giving them copy in writing of card on the car and erasing by two ink lines on both sides of the card the defects repaired. This notice in writing shall be authority for issuing a duplicate card for the partial repairs.

Missing Air-Brake Equipment.—The Central Club would have air-brake hose pipe or angle cocks on cars not equipped with air-brakes at the risk of the owner of the car.

Repairs Chargeable to Car Owners.—The New York Club wants the clause struck out which makes owners of cars pay for renewing worn out brake-shoes and journal brasses. The Western Club would make owners of cars pay for lost oil box covers, worn out M. C. B. coupler knuckles and air-brake hose burst or worn out. The Central Club would make the car owner responsible for journal box missing, center plates and bolts, side bearings and bolts, corner plates, bolster guide bar and blocks broken, cracked pedestals and intermediate sills damaged caused by cars low on trucks and cracked arch bars, when not caused by derailment or wrecks.

Charges for Replacing Axles.—Both the Western and Central clubs want this paragraph added to Rule 8:

In case the owner of a car removes an axle on account of defective wheels, the road responsible for damaging the wheels shall not be charged for any difference in value between the axle used and that removed.

Use of Standard Parts in Car Repairs.—The New York Club would strike out the clause in Rule 15 which requires a company repairing a foreign car to secure the owner's consent before using M. C. B. standard parts in place of the original construction. It would also require cars to be stenciled "M. C. B. pocket or stem, drawbar," as the case may be. It would also strike out the last clause of Rule 19, providing that in repairing foreign cars any link-and-pin drawbar may be used to replace a broken link-and-pin bar, provided the new bar fits properly and is sufficiently strong.

Delay in Reporting Wreck of Car to Owner.—The New York Club would permit a car owner to collect demurrage at Car Association rates if a company destroying the body or trucks of its car does not report the fact to the owner within 30 days.

Schedule of Prices for Car Repairs.—The Central Club would permit an extra labor charge of five hours for replacing intermediate and center sills on cars fitted with air-brakes. The Western Club recommends a revision of the price list for renewal of parts with the addition of prices for wheels,

axles, couplers, knuckles, coupler locks and air-brake hose. A similar recommendation is made by the New York Club.

Expenses of Arbitration.—The New York Club recommends that 75% of the expenses of a meeting of the Arbitration Committee be borne by the party against whom the committee decides.

In addition to the above changes the Western Club after extended discussion adopted a new rule, proposed by Mr. G. W. Rhodes, that when wrong or worn out material is charged to the owner by a company making repairs the owner may request the return of such material at any time within two weeks after receipt of the bill, as evidence of its correctness. It was also voted, on motion of Mr. Schroyer, that old defects should not be carded for except by the owners of the car.

The Central Club recommended the following new rule:

A railroad company should not be held responsible for wrong repairs not made by it on cars passing over its line to the owners, if the wrong repairs were of such a nature as to render it difficult for inspectors to know that such repairs did not conform to the original construction of the car.

WATER PURIFICATION IN AMERICA.

(Continued from p. 336.)

Filter Cribs in the Allegheny River, near Pittsburg.

Many of the water purification plants of this country, probably the majority of them, were put in because of a desire for clear rather than reasonably pure water. The demand for clarification has often been met, especially before the days of mechanical or commercial filters, by the construction of filter cribs, sometimes of adequate size, but often so small or so poorly designed as to have little but a sentimental value. Some cribs recently built in the Allegheny River, near Pittsburg, have been constructed with a considerable area and on scientific principles and are described below by Mr. H. F. Labelle, who has been engineer in charge of the construction of water-works at Verona and Kensington, Pa., under Jas. H. Harlow & Co., of Pittsburg. Mr. Labelle has prepared a description of three of these plants for use in this series of articles, as follows:

The Allegheny River, like all streams flowing through hilly districts, is subject to frequent rises, with accompanying turbidity of its waters. This turbidity is generally produced by fine, brown clay and vegetable detritus of all kinds, washed from the banks. The sedimentation of these substances held in suspension is very slow owing to their fine division and the comparatively great velocity of the current, so much so that the waters of the lower Allegheny are never clear.

This muddiness is objectionable in more than one respect; it tends to clog the water mains, and in suburban towns, where mains are often of a small diameter, it happens sometimes that a 2 or 3-in. pipe will become completely stopped. This deposit of mud often ferments in the hot summer months and generates foul gases which vitiate the whole supply. San Francisco and Oakland, Cal., and numerous other localities, have been affected by this peculiar phenomenon. Muddy water is also objectionable for laundry work, boiler feeding and for the innumerable uses of water in the arts.

In 1888 Mr. James H. Harlow, M. Am. Soc. C. E., of Pittsburg, designed a system of clarification applicable to the Allegheny River and generally to streams flowing on a gravelly or sandy bed. This system has since met with much favor from the water companies doing business in the vicinity of Pittsburg.

The purification of the water is effected by means of a filter crib sunk to a proper depth below the bed of the river and covered with well graduated filtering material.

The estimated cost of a crib designed to filter 15,000,000 gallons per day at a rate of 16,000,000 gallons per acre is $1,600 per million gallons.

In the construction of the Verona and Kensington cribs, described below, provision has been made for back-flushing. A by-pass from force main to suction makes it possible at any time to put the reservoir pressure on the crib.

Judging by the experience gathered at Etna and elsewhere, back-flushing will not be required for a long time, if ever. It has not been possible to find any instance where incipient clogging has been noticed in any filter crib built on the Allegheny and designed in the same manner as the ones illustrated here.

The filter crib differs from the filter gallery in several important points. The yield is mostly from the top and the sides. The water has only 4 ft. of filtering material to traverse. The filtering surface is considerably larger in proportion to cross-section. The structure is designed so as to admit of back-flushing. The cribs are generally placed where the velocity of the current is from 4 to 8 ft. per sec., as these velocities prevent the deposition over the surface of the filter of substances in suspension in the water.

Comparing the filter crib with the settling reservoir, it is believed that the former has several points of superiority. The cost of ground, cleaning and keeping in repairs is nothing, and even when back-flushing has to be resorted to its cost is insignificant; the clarification of water is more perfect and more rapid; the impurities intercepted are taken away by the current; and, lastly, the cost of construction is at least 50% less, exclusive of site.

Filter Crib for the Water-Works of Kensington, Pa.

Fig. 23 shows substantially the construction of the filter crib for the Kensington, Pa., Water-Works, and Fig. 24 shows in plan and profile the crib, suction pipe and pumping station. This filter crib is for the Burrell Water Co., with Jas. H. Harlow & Co. as engineers. The structure is 200 ft. in length, 32 ft. in width and 4 ft. in height. The following is from the specifications:

The width and length of the excavation shall be such that the crib may be sunk to its proper position on a uniform and level bottom. The slopes of the excavation to be such as to permit the earth to keep in position without sliding in the bottom.

The crib shall be built generally of 2×8-in. hemlock plank, of such length as to break joints. The longitudinal rows shall be 4 ft., and the tranverse rows 8 ft. c. to c. Blocks 2×8×8 ins. shall be placed between the rows of longitudinal pieces as shown on Section C. D., Sheet 1. (Fig. 23). At each intersection or point where one plank crosses another, the plank shall be firmly spiked to the one below with 5-in.

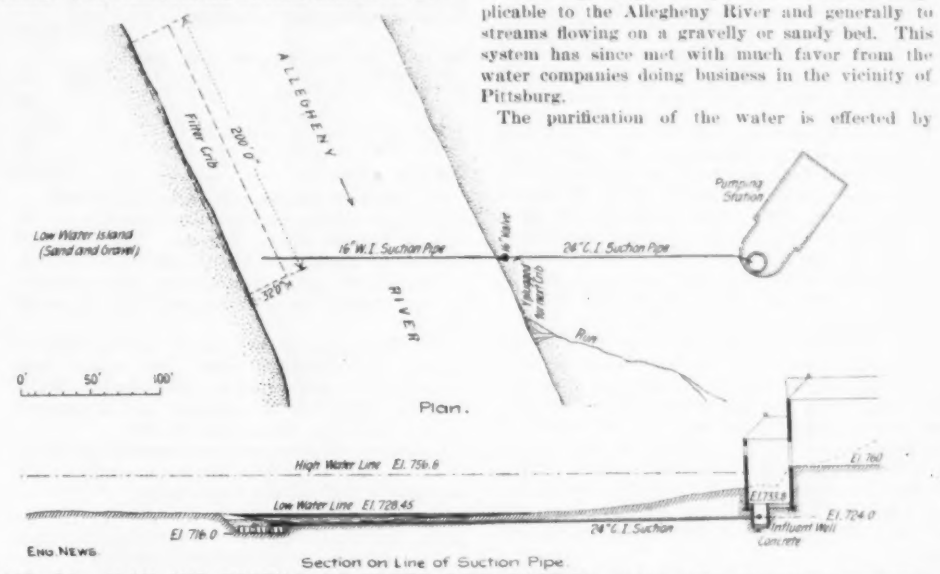
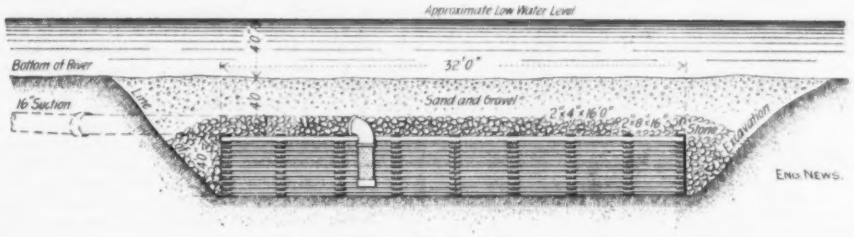
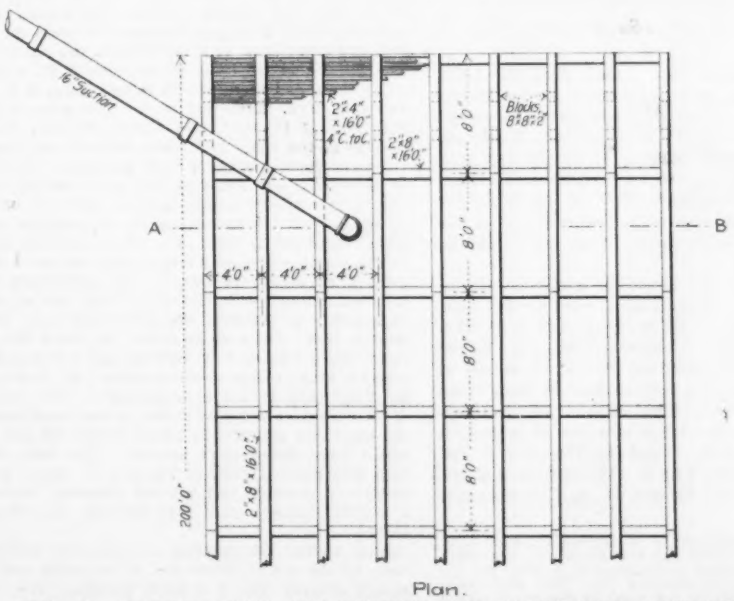


FIG. 24. PLAN AND PROFILE OF FILTER CRIB, SUCTION MAIN AND PUMPING STATION, KENSINGTON, PA.



Section A-B.



Plan.

FIG. 23. PARTIAL PLAN AND SECTIONS OF FILTER CRIB, KENSINGTON, PA.

spikes having large heads. On top of the crib 2×4-in. hemlock shall be placed on edge and spaced about 2 ins. apart, to prevent the stone from falling into the crib. These 2×4s shall be secured in their place by capping pieces, all to be firmly spiked together with spikes 9 ins. long.

When the crib is ready for sinking, it shall be uniformly loaded on the top with stone sufficient in quantity to sink it. After the crib has been satisfactorily sunk to its position, stones shall be filled about the sides to prevent the gravel from working into the crib, and then the hole caused by the excavation shall be refilled to lines with selected gravel and sand.

It usually takes about 1 ft. of stone to sink such a crib as the one just mentioned. The gravel and sand are dredged directly from the bed of the river and dropped over the crib by means of bottom dumping scows. The proper graduation of filtering material is easily obtained without screening, as the bars contain gravel of different sizes, which is sometimes devoid of sand and sometimes contains as much as 60% of this material. The latter is generally used for the last 2 ft. of the covering.

The method of sinking is as follows: The crib is placed between two scows containing the stone and firmly lashed to them; the crib and scows are then taken over the excavation, which has previously been carefully leveled, and the system is anchored upstream. The strainer is then secured in place and the suction line put in to shore. When loaded the crib is gradually lowered by letting out the ropes until it reaches the bottom. The ropes are then pulled from under the crib by a steam capstan.

The Kensington crib is designed for a capacity of 3,000,000 gallons per day, which gives 363 gallons per sq. ft. of area, or about 16,000,000 gallons per acre, on the supposition that the sides will filter at the same velocity as the top. This rate of filtration is much more rapid than the ones in use in the majority of filter beds, but even this rapid filtration gives the result contemplated, which is the clarification of the water. The estimated cost of the Kensington crib is $2,400 per million gallons. Provision is made for back-flushing to cleanse the filtering material, as described above.

This crib will probably be completed by June 1, 1894, but the pumping plant will not be ready for operation before July 1. The Kensington works will supply the borough of that name located about 20 miles north of Pittsburg, in Westmoreland County, and having a population of some 6,000.

Filter Cribs for the Water-Works of Etna, Pa.

The filter crib of the Etna Water-Works, where the first design was tried, is 5½ miles above the junction of the Monongahela and Allegheny rivers, and has been in use continuously since January, 1889. The water served to the consumers is at all times clear, approaching distilled water in limpidness.

It is believed that the action of the filter crib is not only one of clarification, but that part of the organic matter is also intercepted. I quote on this subject from Prof. F. C. Phillips' report on the water supply of Allegheny City:

> It is an important result of analysis, that whatever may be the source of pollution, the organic matters exist in, or pass into a condition of union with the particles of floating clay. Hence the serious importance of adopting a process of purification by which the water may be clarified. The condition of the impurities justifies the belief that by suitable treatment a great improvement may be effected. Such improvement should include complete clarification, for the removal of the sediment by any effective method insures at the same time a material reduction in the proportion of organic matters.

In September, 1893, Dr. E. G. Matson, of Pittsburg, made a bacteriological analysis of the water in use at Etna; samples were taken from the river over the crib and from a faucet located in the pumping station, and he found that the unfiltered water contained 613 and the filtered water 576 bacteria per cu. cm. The filtering material at Etna is 4 ft. thick and is simply of gravel dredged from the river bed. This gravel does not contain more than 40% of sand and the results obtained by sand filtration, properly speaking, cannot be expected here. However, the working of the filter shows an elimination of 6% of the bacteria. This percentage would no doubt be considerably increased by giving a greater thickness to the bed and also by increasing the proportion of sand.

Filter Crib for the Verona Water-Works at Hulton, Pa.

The cost of the filter crib lately completed for the Verona Water-Works at Hulton, Pa., was as follows:

15,000 ft. hemlock, $14	$210	
Labor constructing crib	36	
Spikes	8	
Dredging, sinking and back-filling	900	
		$1,154
260 ft., 12 in. wrought iron suction, laid, $2.25	$585	
Strainer	36	
		621
Actual cost		$1,775
Profit, 34%		610
Contract price		$2,385

The contract for the crib alone was $1,800, or $2,400 per million gallons. The capacity of the crib is 750,000 gallons per day. The estimated cost of the Kensington filter, exclusive of suction, is also $2,400 per million gallons, and provision has been made for back-flushing, both as stated above.

The Verona works will supply the boroughs of Verona and Oakmont, about ten miles from Pittsburg, and are owned by the Suburban Water Co. The filter crib is completed and is expected to be in operation before June 1, 1894.

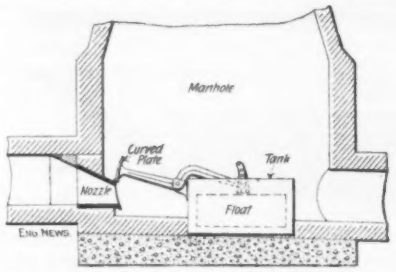
Filter cribs similar to those described above are in use in connection with the water supply of the boroughs of Millvale and Sharpsburg.

THE METROPOLITAN SEWERAGE SYSTEMS OF MASSACHUSETTS.

(Continued from p. 382.—With inset.)

On so large and important a piece of work as the Metropolitan Sewerage System many complicated problems naturally arose relating to the crossings of or connections with other sewers. The solution of a number of these problems is presented on the accompanying inset sheet and in the text below.

One of the most complicated sewer connections is located on the Charles River Valley system, where the Brookline main sewer connects with the Metropolitan, as shown in Figs. 1 and 2 on the inset. At this point tide gates were built in the Brookline sewer and a connection was made to permit the Metropolitan sewer to discharge into the Brookline outlet, in case of accident to the Metropolitan below the point of junction. Provision is also made for conveying the ordinary flow of the Brookline sewer into the Metropolitan system, the cost of this part of the work being borne by the city of Brookline.



Regulator in Brookline Sewer Connection.

The tide gates in the Brookline sewer are shown at the left in the plan, Fig. 1, and at the right in Section F, Fig. 2. In the plan and in Section JK, Fig. 1, as also in Section GH, Fig. 2, the stop planks and overflow are shown, by means of which the Metropolitan sewage may be turned into the Brookline sewer. The method of diverting sewage from the Brookline into the Metropolitan sewer may be seen by examining the plan in Fig. 1 and Section ABCD, Fig. 2. The operation of the regulator is described by Mr. H. A. Carson, Chief Engineer:

> The object of a regulator is to shut off the flow from the common sewer when the sewage in the Metropolitan sewer has reached a determined height, as, for instance, half or three-quarters full. The mechanism for accomplishing this is indicated in the rough sketch enclosed (and reproduced herewith). A float in the case in question rises and falls in a cast iron tank. This tank has a connection (not shown), so that the water in it is at the same level as that in the Metropolitan sewer. A lever arm, hinged on one end of the tank, carries a curved plate on one end very close to the nozzle. The other end of the lever arm is attached to the float. As the float rises the plate descends and shuts off the flow. The general design for this sort of regulator was determined fifteen years ago or more by Joseph P. Davis, then City Engineer of Boston. Our drawings fully illustrating this were destroyed in the fire.

Two sewer crossings are shown on the inset, both being on Contract Section E of the Charles River Valley System, in the Brighton district of Boston, the Metropolitan sewer in each case crossing a Boston city sewer. Fig. 3 shows a crossing and overflow at the Parson's Brook sewer, where quicksand was encountered and sheet piling and a pile foundation were used. The Metropolitan sewer is carried through an enlargement of the Boston sewer by means of about 17 ft. of 58-in. iron pipe, as shown by the plan and by Section AB, Fig. 3. A lift gate near the upper end of the iron pipe is provided to divert the Metropolitan sewage into the Boston sewer through the connection between the two shown in the plan and in Sections CD and EF, Fig. 3.

The crossing of the Western Ave. sewer, the second one mentioned in the preceding paragraph, is shown in plan, longitudinal and cross-section by Fig. 4. Here, as with the Parson's Creek sewer, the axes of the sewers were very nearly on a level and the city sewage was carried both over and under the Metropolitan sewer by means of iron pipes.

Two bell mouths are shown on the inset by Figs. 5 and 6. Fig. 5 shows a bell mouth located on Contract Section 16, in Everett, at the junction with Contract Section 23, which comes down from Cambridge and Somerville. The bell mouth shown by Fig. 6 is on Contract Section 27, in Cambridge. These bell mouths are shown in detail by the illustrations and need no further comment.

THE USE OF CANVAS IN WATER-TIGHT BULKHEADS.*

By M. Meigs.

The use of canvas stretched over loosely fitted boards to form watertight construction is not new. It can be advantageously used in many difficult situations, and the object of the paper is to show one such use. The writer considers it especially adapted to the construction of cofferdams, especially on rock bottom; the suppression of leaks in embankments, such as levees during high water, and the suppression of leaks in foundations, such as important reservoir dams. It has long been in use for raising sunken vessels on our Western rivers.

The U. S. Mississippi River Canal, at Keokuk, Ia., has been in use since 1877. It has a lock at each end, and one in the middle. To clean and repair the upper lock, it was, on two occasions, separated from the river by a cofferdam of plank and mud. Each time the work had to be done after the close of navigation, during inclement weather, and on one occasion the imperfectly consolidated dam upset just as a blizzard came on, which froze fast the tow boat, dredge and barges, and stopped work for the winter. In the autumn of 1893 it became necessary to drain the lower lock and examine it, as it had been in use for 16 years. The filling and emptying culverts are 8 ft. wide and 16 ft. high, and there are 16 culvert gates 3 ft. wide and 6 ft. high. Each leaf of the lock gates is 27 ft. high and 46 ft. wide, and weighs 40 tons, and the leakage of the lower 10 ft. was becoming serious.

Repairs could not begin until November on account of traffic. A low stage of the river usually occurs late in this month, but as soon as cold weather sets in the anchor ice causes sudden fluctuations in the level. Generally it rises to a 4-ft. stage, but going of the ice may greatly increase this; so that a cofferdam 16 ft. above the bed or 8 ft. above low water was not deemed safe. To have built this of gravel and timber in freezing weather would have been a difficult task. About 40 ft. below the lower mitre sill there was a smooth rock bottom, and a bulkhead was erected, with its ends abutting against the flaring ashlar wing-walls of the lock approach. This consisted of 13 triangular bents of timber placed lengthwise of the canal and spaced 8 ft. apart, except the end ones, which were flared down stream. The face of the dam was given a slope of 1½ to 1, to secure greater downward pressure and prevent slipping. Purlins of 8 × 12-in. timbers, and light bracing, etc., were attached.

After towing this framing to place, the whole was sunk by the use of 60,000 lbs. of old rails, and then closely covered with 3 × 12-in. planks. The timber was not mortised in any way, but fastened by cleats and other special attachments. As the bottom had been kept clean by the scour from the discharge culverts, the dam settled smoothly to place. This was determined by a diver sent down for the purpose, the water being up to this time about 10 ft. deep. In spiking the planks two spikes were used at the lower

* Abstract (from the Society's bulletin) of paper presented at the meeting of the American Society of Civil Engineers, May 2.

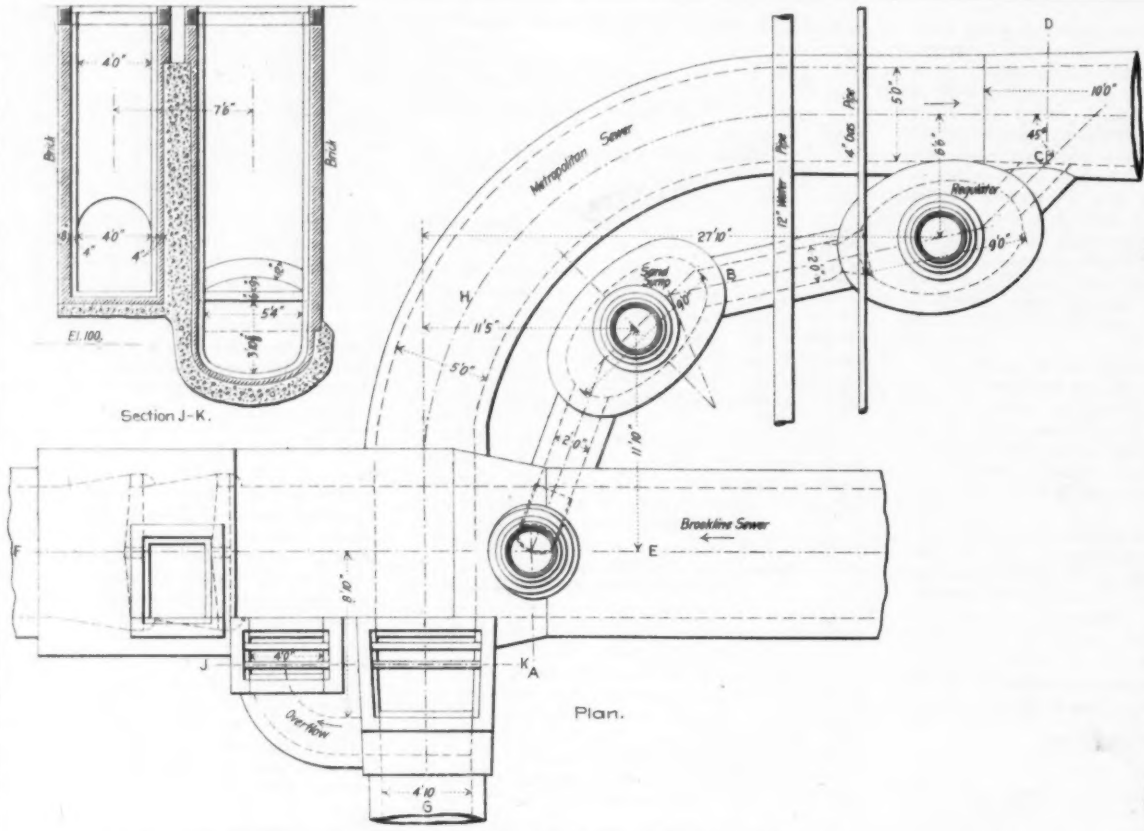


FIG. 1. PLAN AND SECTION, CONNECTION WITH BROOKLINE MAIN SEWER.

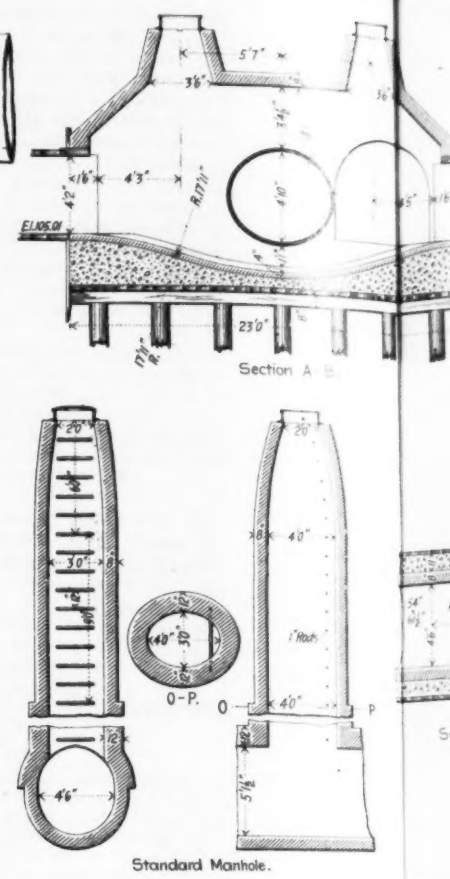


FIG. 3. DETAILS OF C

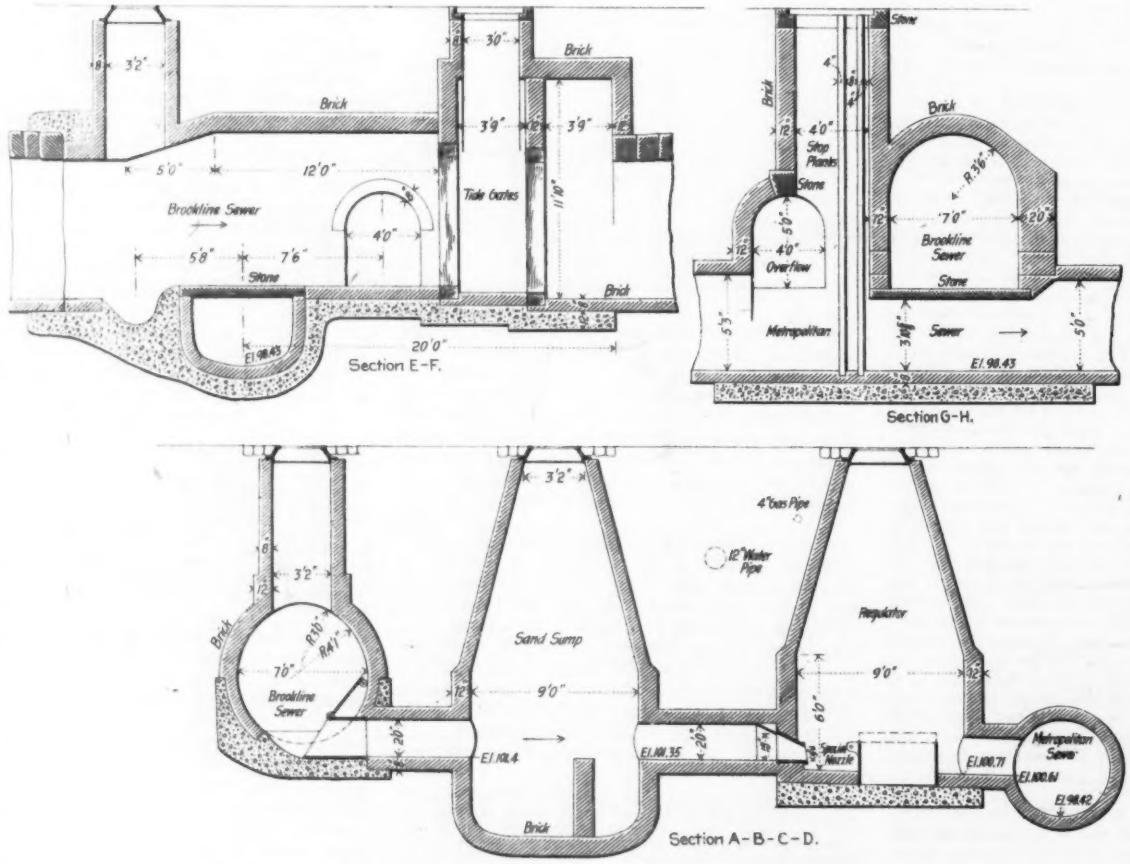
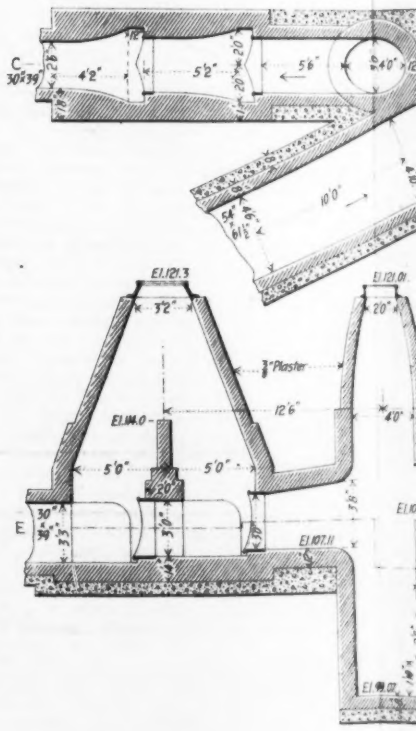


FIG. 2. SECTIONS, CONNECTION WITH BROOKLINE MAIN SEWER.



FI

METROPOLITAN SEWERAGE SYSTE

CONNECTION WITH BROOKLINE MAIN SEWERS, CROSSING OF WESTERN AVENU

Howard Carson, Chief Engineer; Hosea Kingman, Tilly

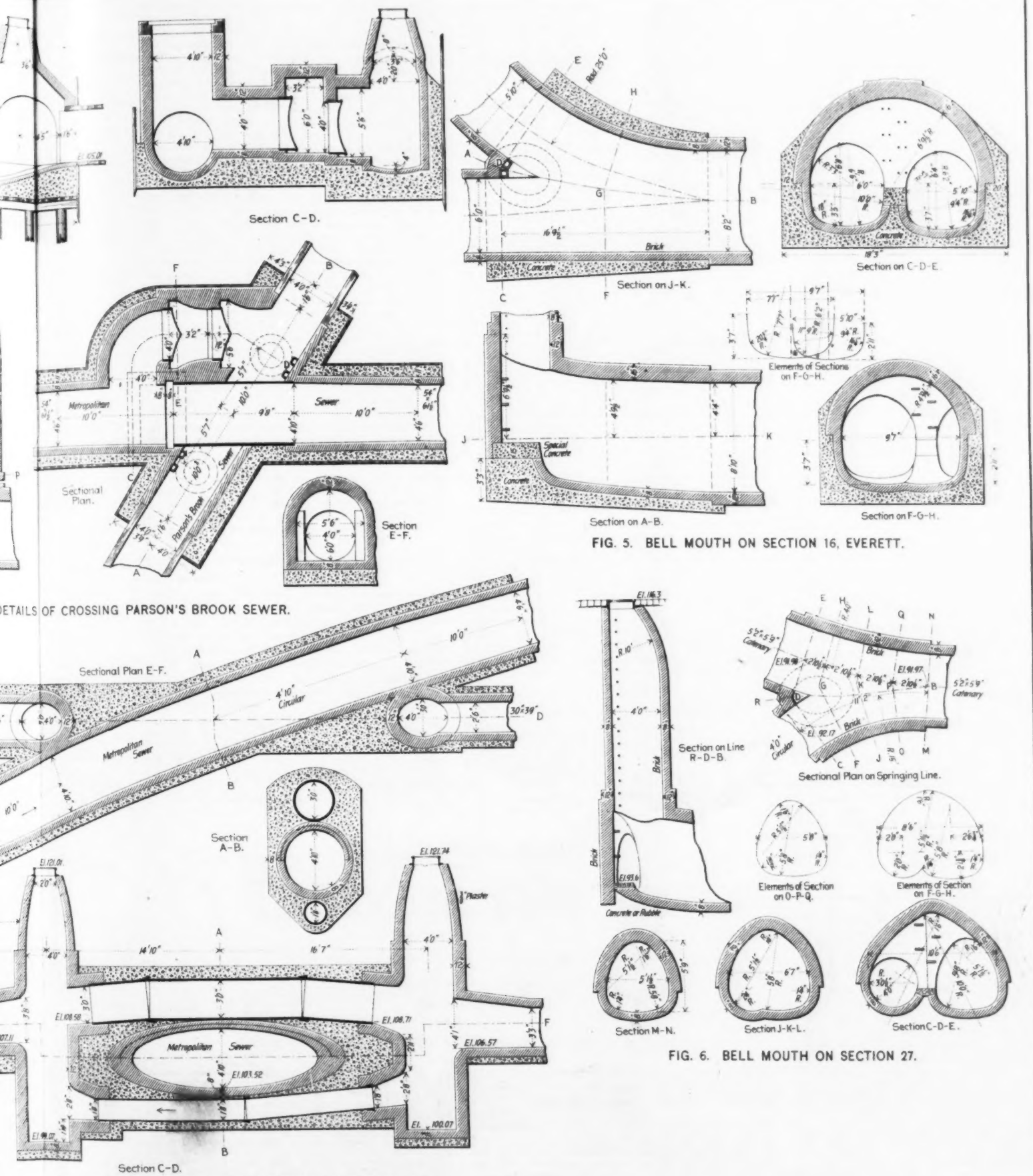


FIG. 5. BELL MOUTH ON SECTION 16, EVERETT.

DETAILS OF CROSSING PARSON'S BROOK SEWER.

FIG. 6. BELL MOUTH ON SECTION 27.

FIG. 4. DETAILS OF CROSSING WESTERN AVENUE SEWER.

E SYSTEMS OF MASSACHUSETTS:

N AVENUE AND OF PARSONS BROOKS SEWERS AND DETAILS OF BELL MOUTH.

gman, Tilly Haynes, Harvey N. Collison, Commissioners.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

purlins, and one at the upper end. Those below water were started before sending the plank down, and were driven with a "shot gun" from the barge. This apparatus consisted of a ¾-in. pipe, with an iron rod working in it for a hammer; the pipe was put in place by the diver. The lower tier of planks was 16 ft. long, but 18 ft. would have been better.

The canvas sheet used to give tightness to the apron was of 12-oz. duck in two 10-ft. and one 6-ft. breadth, sewed together at the edges, and was about 4 ft. longer than the extreme length of the apron. A ½-in. iron chain was sewed to the lower edge to act as a sinker and make it hug the bottom, on which it lapped about 12 ins.; it also extended some inches on the wing-wall. It was spread by the diver, and cleats were nailed on the angle between the apron and the wing-wall, also along the upper edge. At one place at the ragged hole in the rock bottom, beveled stop-waters were used. The placing of the dam occupied nearly five days, on some of which it was too cold for the diver to work continuously; and the river closed two days after the water was pumped out. When all was in readiness the lock was pumped dry in six hours. The tightness of the dam surprised everybody; all leakage could have been easily removed by a hand pump, but a pulsometer was used intermittently. Some anxiety was felt as to the effect of ice freezing fast to the canvas, for fear the rise and fall of the water would tear the canvas; but it froze fast to the planks beneath and there was no trouble. The greatest head of water was 12 ft. An apron of poles would probably have sufficed for a support to the canvas. By using a wider lap on the bottom it might be used where the bottom was gravel.

Experiments show that with water containing considerable silt no large amount of seepage occurs under a head of 22½ ft., and that no tearing occurred under a pressure of 800 lbs. on a circle 4½ ins. in diameter. The writer described the use of canvas in a similar manner for stopping leaks in raising sunken vessels, and proposes its use in stopping springs in foundations, etc. The total cost of the bulkhead was $1,159, from which $400 can be deducted for material saved.

A NOVEL METHOD OF STOPPING A LANDSLIDE AT SEATTLE, WASH.

During the year 1892 it was decided to take measures to stop a landslide at Seattle, Wash., which had been obstructing South Fourteenth St. between Lane and Canal Sts., for several years.

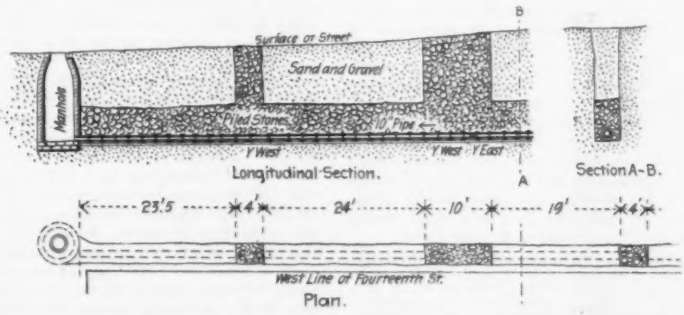
The repairing of the street was referred to Mr. R. H. Thomson, City Engineer, who, in his report for 1892, described the original conditions and the method employed in making the repairs in the following language:

Within these limits, as the street was originally constructed, there was a fill of depth varying from 5 ft. to 30 ft. This fill was unfortunately placed upon a stratum of broken and pulverized clay, overlying a bed of very hard, smooth clay, over which a small stream of water was constantly running, seeping from the sand-covered ridge above. The body of the pulverized clay being thus dampened, its tendency was to slide upon the smooth surface below, carrying the entire roadway constantly to the eastward. In accordance with my recommendation, a plan is being carried out by which the water is to be cut off from crossing the street. A ditch, 4 to 5 ft. in width, has been excavated along the west margin of street the entire length of the block, the bottom of the ditch entering the substratum of hard material before mentioned. Along this bed, resting upon a tier of 4-in. plank, 12 ins. in width, a continuous 10-in. sewer pipe has been laid with open joints and with numerous "Y's" opening to the westward. Around and above the pipe, to a height of about 5 ft., broken stone has been carefully laid, forming an intercepting drain to catch the seepage of water from all sides and especially from the west. Over each "Y" a column of broken rock has been carried up to the surface, and the spaces between the columns were filled with loose material. The lower end of the drain pipe is connected from two "Y's" to the 15-in. sewer extended up South 14th St. to a point about 50 ft. south of Lane St., in order to receive the discharge. Though the drain is not entirely completed, enough has been done to thoroughly demonstrate the value and efficiency of the method of repair. After heavy storms the roadway has been left in a condition better than it was before accustomed to be, even in good weather, proving that the seepage is entirely intercepted. The only possible cause for further slides after this drain is completed will be from the removal of clay in the brickyard to the eastward, and the consequent undermining of the street. The accompanying sketch shows the plan of construction adopted and followed.

In response to a request for information regarding the date of completing the above work and the success of the means employed, Mr. Thomson writes us under date of April 2, 1894, that the repairs were completed about Feb. 1, 1893. Since that time, he states, no slide or movement has occurred and the water appears to have been entirely intercepted by the drain. Mr. Thomson writes further regarding the drain as follows:

About the first of last September we had an unusually heavy rainstorm, and owing to the carelessness of the street gang, sand was allowed to pour into the drain through the upper catch basin and entirely filled a section about 50 ft. in length, this section being about 200 ft. from the upper end of the block, which has a total length of 600 ft. The exact position of the choked portion was located through the manholes, and the street was opened over the lower end of the obstruction and the deposit removed. We found that the water which came from above the obstruction passed through the open joints of the pipe, and followed along the rock drain, re-entering the pipe a short distance below the obstruction. I have no doubt that had the drain been left alone it would have eventually cleared itself.

This experience has suggested to me the thought that if I had occasion to undertake a similar repair in the future, I would have all joints of the large pipe carefully cemented and trust entirely to small tile laid alongside the large pipe surrounded by shingle and introduced at the "Y's," to effect the drainage.



DRAIN EMPLOYED TO STOP A LANDSLIDE AT SEATTLE, WASH.

TEST OF AN ALLIS TRIPLE EXPANSION PUMPING ENGINE AT TRENTON, N. J.

A test of a 10,000,000-gallon triple-compound Allis pumping engine connected with the city waterworks of Trenton, N. J., was recently made by Samuel Webber, M. Am. Soc. M. E., for the Board of Public Works of that city, of which Mr. G. D. W. Vroom is president. During the test the water was pumped to a height of about 120 ft. The main facts in Mr. Webber's report are as follows:

By agreement with your board and the builders of engine, the test was limited to 8 hours instead of 24 as per contract, the combustion of fuel not entering into the agreement, and 8 hours being ample time to test the pumps without danger of overflowing the reservoir.

The tests were made between the hours of 9 a. m. and 5 p. m. April 28. The tables of results show:

Revolutions per minute	30.71
Average steam pressure at engine, lbs.	112.27
Average height of water lifted, ft.	119.62
Average temperature of water, feed and pumps	59° F.
Gallons pumped in 8 hours	3,451,015
Duty per 1,000 lbs. water, used in steam	136,233,000
Rate of pumpage per 24 hours, gallons	10,353,040

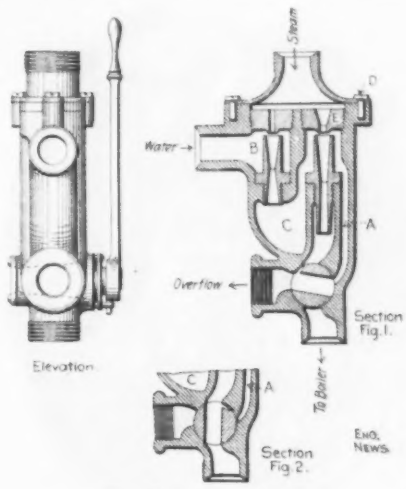
Were the conditions noted changed to the exact terms of the contract (110 lbs. steam and 30 revs. per min.), the duty per 1,000 lbs. would be 133,856,000, and the gallons pumped in 24 hours, 10,113,680, instead of 10,353,040, as shown at the trial.

The following data, not strictly relating to the necessary test of the engine and pumps, are also interesting as showing excellent results from the boilers and the slow combustion of coal which the ample boiler-room afforded:

Area grate surface three boilers, sq. ft.	70.75
Area heating surface three boilers, sq. ft.	2,307.30
Total coal burned, lbs.	2,067.00
Total ashes, lbs.	163.00
Per cent ashes	6 1-10
Coal per sq. ft. of grate per hour, lbs.	4.71
Actual evaporation per lb. of coal at 50° F., lbs.	9.48
Equivalent " " " " " from and at 212°, lbs.	11.05
Feed water per I. HP. per hour, lbs.	13.45
Coal per I. HP. per hour, lbs.	1.42

THE BROWNLEY INJECTOR.

We illustrate herewith the Brownley injector, a recently invented boiler-feeding device, adapted for either locomotives or stationary boilers. The injector is simple in design, the arrangement of the steam and water passages being shown in the section, Fig. 1, where the plug or cock is shown in position for starting. In this position the steam



The Brownley Injector.

when turned on passes through the side passage A, exhausts the air from the lifting chamber B and starts a flow of water through the injector. As soon as there is a steady flow of water from the overflow the handle is thrown over, turning the plug so as to give a passage from the nozzle to the pipe leading to the boiler, as shown in Fig. 2. The plug is made taper so that in case of wear it can be driven up. There are no valves and in case of dirty feed water being used, as on contractors' engines, the dirt, etc., will largely collect in the chamber C. It is best to take the steam from the dome, but it may also be taken from the steam pipe. The injector will lift hot water, and the water can therefore be fed from the hot-well. A pressure of only 15 lbs. per sq. in. is required for starting with a lift of 5 ft., 20 lbs. for 10 ft., 35 lbs. for 20 ft., and 45 lbs. for 25 ft. It works either at high or low pressure, and if the check valve or feed pipe leaks, the plug acts as a check and prevents the leakage from emptying the boiler. It is not liable to breakage, but can be got at readily for renewals or repairs by taking out the screws D and removing the top plug E. This injector is the invention of Patrick Brownley, of Canada, and is being introduced by the Young Nut Lock Co., of 150 Broadway, New York. Several of the injectors are now in use.

A HAND-CAR WHEEL OF PRESSED STEEL.

There has been rapid evolution in the design of hand-car wheels during the past dozen years. The old cast iron wheel was displaced first by wheels built up of cast iron and wrought iron, and later by composite steel and iron wheels. These early types of wheels, however, were unable to withstand the severe strains to which they were subjected, and when put in service they developed a tendency to rattle and a lack of durability. The wood center wheels were the next to come into vogue, and their lightness and freedom from vibration and noise brought them into rapid popularity. This lasted until experience developed the fact that the exposure to weather which a hand-car wheel must endure is a barrier to long life for a wood center wheel, especially on railways in the South. A second cause for the decline of the wood center wheel was the development of all-steel wheels of superior design and durability.

Among the latest designs of all-steel wheels is that illustrated herewith, made by the Buda Foundry & Mfg. Co., of Harvey, Ill. It is of interest, moreover, as an example of the capabilities of steel when worked under the hydraulic press, the spinning lathe and the drop hammer. The tread, flange and web of this wheel are formed by drawing and spinning a single disk of 3-16-in. steel

plate. This disk is heated to a cherry-red, the hole for the hub being first punched, and placed in a 500-ton hydraulic press, which dishes the center, forms the corrugations and turns the outer part of the disk over to form the tread of the wheel. The rough shape is then reheated and placed in the spinning machine, which, by means of suitably shaped rolls, completes the formation of the wheel

Pressed Steel Wheel for Hand Cars, Buda Foundry & Mfg. Co., Harvey, Ill.

tread and flange. These rolls are ingeniously devised to compress the metal and make the thickness of the tread where the wear comes considerably greater than the original thickness of the plate, as is clearly shown in the cut. The tread and flange being completed, the holes are punched in the web between the spokes and the wheel is ready for the insertion of the hub. This is of malleable iron. The two parts, hub and collar, are assembled by a drop hammer, the rivet holes are drilled and the rivets are driven by a hydraulic riveter. There are six 7-16-in. rivets, and they are driven three at a time, it being found that this gives a better result than if all six are driven at once. It is evident that the great pressures used in assembling the hub and driving the rivets secures a very rigid connection between the hub and the web of the wheel. In fact, it is asserted that the fit of the hub is so tight that in service practically no shearing stress comes on the rivets.

The claims made for this wheel by the manufactures are:

(1) The tread, flange and web of wheel are all formed from a single plate of steel by the drawing and spinning processes, thereby preventing the shocks and strains to which the metal would be subjected were a drop hammer employed for the purpose.
(2) The tread of the wheel having a re-enforcement or backing of metal at the line of contact with the rail, insures greater strength as well as increased life.
(3) The wheels are absolutely round and true, and will retain their shape after the tread has worn thin from continued service. This is an advantage effected by the re-enforcement of the tread.
(4) The relative location of the web to the tread line of the wheel, and the projection of the hub being on the front side of the web, afford the greatest resistance to both the crushing and lateral strains to which the wheel will be subjected in service.

The steel used is a good quality of plate steel, sufficiently high in carbon to insure good wearing qualities to the tread and flange. The complete wheel weighs 40 lbs.

PERSONALS.

Mr. A. M. Long has been appointed Surveyor of Dade County, Mo., vice Mr. W. A. Allison, resigned.

Mr. Walter F. Randall, of Syracuse, N. Y., has been chosen Chief Engineer by the Board of Water Commissioners of that city.

Mr. Geo. A. Black, Assistant Engineer of the Maine Central R. R., has been appointed Superintendent of the White Mountain Division, with headquarters at Lancaster, N. H.

Gen. George S. Greene, M. Am. Soc. C. E., attained the age of 93 on May 6. As noted in our issue of Dec. 28, 1893, he is the oldest graduate of West Point, having graduated in 1823.

Mr. Joseph Menge, of New Orleans, La., the inventor of the Menge dredge and irrigation pump, died recently at Monterey, Mexico. He graduated from the University of Missouri in 1870.

Mr. L. T. Myers has resigned his position as General Superintendent of the Seaboard Air Line to accept a position with the Richmond, Fredericksburg & Potomac R. R., of which his father, Mr. E. T. D. Myers, M. Am. Soc. C. E., is president.

Mr. N. W. Eayrs, M. Am. Soc. C. E., Superintendent of Structure and Interlocking of the Terminal Railway Association of St. Louis, has been appointed Superintendent of Structure of the St. Louis Merchants' Bridge and St. Louis Merchants' Bridge Terminal Ry. also, the latter companies being now controlled and operated by the Terminal Railway Association.

Dr. Charles R. Keys, of Des Moines, Ia., has been appointed State Geologist of Missouri, vice Prof. Arthur Winslow. He is a graduate of Johns Hopkins University and was connected with the geological survey of Missouri two years, and previous to accepting the position of Assistant State Geologist of Iowa served some time on the U. S. Geological Survey. He is the author of several works on geological subjects.

NEW PUBLICATIONS.

MAY MAGAZINES.—In "The Century" this month Nikola Tesla, whose fame as an electrician is world-wide, reveals his ability in a widely different field. A brief description of Zmai Iovan Iovanovich, the chief Servian poet, is written by Tesla himself, and three poems of remarkable power follow translated from the Servian by Mr. Tesla and Mr. Robert Underwood Johnson. We said a widely different field, but we are not sure that the inborn fervor that urges the poet's pen and that which spurs onward the inventor are so different after all. In each the imagination, the creative faculty, is the ruling power. This is not the place to criticise poetry; but incidentally we may say that these translations from the Servian have a native strength and zest which one looks for in vain in English poetry of the present day. In "Scribner's" Capt. John G. Bourke, U. S. A., describes the American Congo, by which he designates that part of southwestern Texas lying between the Rio Nueces and the Rio Grande, a territory which is destined to become an important field for the irrigation engineer.

In the "North American Review" Surgeon-General Sternberg, U. S. A., advocates the establishment of a National Health Bureau in the Department of the Interior, in accordance with a bill prepared by a committee of the New York Academy of Medicine and now pending in Congress. An article of exceeding interest in this number is that in which Hon. Nathan Strauss describes the manner in which he has conducted one of the most beneficial and helpful charities that New York city has ever seen. "Helping Others to Help Themselves" is the heading which the author places on his paper, and it expresses well the principle on which all wise charity should proceed. Those interested in naval affairs shou'd read Admiral Colomb's discussion of "England's Position in the Mediterranean" in this magazine. According to the gallant admiral, England, with all its swarm of war vessels, great and small, is in dire danger of having a large slice of its commerce annihilated at the first smell of war with a foreign power. The whole tenor of his argument is to urge new appropriations for new ships, which it is well to remember may be rendered obsolete by improvements in guns or armor or explosives or aerial or submarine navigation by the time they are completed.

In the "Forum" the advantages and disadvantages of helping the unemployed by starting public works are discussed by Dr. Stanton Colt and Mr. D. McG. Means. So much of this work has been done during the past winter that the discussion is very timely.

COMPENDIUM OF TRANSPORTATION THEORIES. A Compilation of Essays upon Transportation Subjects by Eminent Experts. Prepared by C. C. McCain, of the Interstate Commerce Commission. Washington, Kensington Publishing Co. Cloth, 8vo; pp. 300; $2.

This volume, as explained by its title, is a reprint of essays, addresses, etc., on railway transportation problems and questions, and its purpose is to form a handy compilation which will be of interest and value to railway officers, students of the "railway problem" and others interested in the social and economic effect of modern transportation systems. There is no review of the subjects or comments upon the conclusions presented. Of the 34 essays the majority (including some by Hon. Thomas M. Cooley, Hon. Augustus Schoonmaker, Mr. A. B. Stickney and other well known writers on railway affairs) deal with the theory of the problem, and the question of government control, etc., from different points of view, but there are also essays on freight and traffic questions, employees, high speed travel (by Mr. Theodore Voorhees), English and American railways (by Mr. W. M. Acworth), and the relations between American and Canadian railways (by Mr. A. C. Raymond). It is certainly an interesting volume, and it is well that the several essays on these subjects should thus be collected and preserved. The book is well printed, in clear type, and has a list of contents, but no index.

SOCIETY PROCEEDINGS.

TECHNICAL SOCIETY OF THE PACIFIC COAST.—At the meeting on May 4, a paper on "Concrete at Fort Point," by Col. George H. Mendell, was read by Lieut. Flagler.

CIVIL ENGINEERS' CLUB OF CLEVELAND.—At the meeting on May 8, a paper was presented by E. J. Fort and C. W. L. Filkins, on "Stresses and Deflections in Circular Hoops under Various Conditions of Loading," and another by A. E. Brown, on "The Design and Tests of a High Speed Electric Cantilever Crane for Shipbuilding."

LIVERPOOL ENGINEERING SOCIETY.—At the meeting on April 18, Mr. Thomas Duncanson, Assoc. M. Inst. C. E., read a paper entitled "Notes on the Distribution of Water Supplies." He gave particulars as to the quantity of water required to be provided for the supply of a district and the variations in the rates at which it must be supplied, showing that the maximum rate at any hour during the year exceeds the average by about 85%.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—At the meeting on April 19, Mr. Gustave Kaufman presented the report of the subcommittee on pure water supply for Pittsburg and Allegheny, and in accordance with its recommendation a standing committee was appointed, consisting of Messrs. Davison, Harlow and Kaufman, to consider matters relative to a pure water supply. Dr. Phillips exhibited specimens of large glass tubes made by the Appert process and read a paper on their manufacture. Mr. Thos. H. Johnson read a paper entitled "The Theory of Dynamic Work Applied to Static Forces."

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on May 2, a resolution sent in by Mr. Katte, calling for the appointment of a committee on the relation of wheel gage to track gage to work in conjunction with the M. C. B. committee on the subject was presented, but was unfortunately lost owing to the small attendance, there being only 21 out of a necessary vote of 25 in favor of submitting the resolution to the Board of Directors. The matter was the outcome of the paper read at the last meeting by Mr. A. A. Schenck (Eng. News, April 19). Two papers were presented, on "The Use of Canvas in Water Tight Bulkheads," by M. Meigs, and "Notes on the Great Kanawha Improvement and the Chanoine Dams," by A. M. Scott. Owing to the depletion of the collation fund the usual refreshments after the meeting were omitted.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on May 2 Mr. Robert Moore read a paper on "The Filtration of City Water Supply in the Light of Recent Researches." He placed the cost of a filter system for the city of St. Louis at $2,000,000, and the annual expense of operation, maintenance and interest charges at $150,000. As the filtration of the water supply would undoubtedly reduce the number of typhoid cases by half, to say nothing of other advantages, the adoption of filtration for the water supply was strongly recommended.

In the discussion Mr. Holman stated that plans were being made and experiments conducted upon various systems. The water department would be ready to act in the matter when funds were available. In the further discussion it was stated that most of the work in the filter bed is done in a thin layer on the top, and that the cleaning process consists mainly of scraping off this layer whenever it became too dense to permit the ready flow of water. It was anticipated that the filtering of 50,000,000 gallons of water per day would cause a deposit of 1,000 tons of mud, but most of this would be taken out in the settling basins, where fully 90% would go down in the first eight hours. This would greatly lighten the task on the filters. It was shown that it would be desirable to treat the water with a coagulant and also to cover the filter beds.

Wm. H. Bryan, Secy.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The annual meeting will be held at the house of the Engineers' Club, 1122 Girard St., Philadelphia, beginning at 10 a. m., Tuesday, May 15, 1894. Mayor Stuart, of Philadelphia, will deliver an address of welcome, the yearly reports will be submitted, officers elected, and other business transacted, including action on a resolution favoring legalization of the units adopted at the Chicago Electrical Congress. The following papers are to be presented: "A Review of the Progress of the American Institute of Electrical Engineers," by the president, Prof. Edwin J. Houston, of Philadelphia; "Light Distribution and the Use of Lamps," by Prof. Wm. A. Anthony, Vineland, N. J.; "Discriminating Lightning Arresters and Recent Progress in Means for Protection against Lightning," by

Alexander Jay Wurts, Pittsburg; "Central Station Economy," by Mr. C. Reginald Van Trump, Wilmington, Del.; "Unipolar Dynamos for Electric Light and Power," by Prof. Francis B. Crocker and Mr. C. Howard Parmly, New York; "Relative Advantages of Toothed and Smooth Core Armatures," by Mr. Alton D. Adams, Worcester, Mass.; "Test for Closed Coil Arc Dynamo," by Prof. R. B. Owens, Lincoln, Neb.; "Alternating Currents and Fuse Wires," by Prof. Dugald C. Jackson and Mr. R. J. Ochsner, Madison, Wis.; "Some Storage Battery Phenomena," by Mr. W. W. Griscom, Haverford, Pa.; "Resonance Analysis of Alternating and Polyphase Currents," by Prof. M. I. Pupin, New York; "Some Facts about Polyphase Motors," by Dr. Louis Bell, Boston; "The Law of Hysteresis (Part 3) and the Calculation of Ferric Inductances," by Mr. Chas. Proteus Steinmetz, Schenectady, N. Y.; "Experiments with Two-Phase Motors," by Dr. Louis Duncan, Baltimore.

INTERNATIONAL CONGRESS ON INTERNAL NAVIGATION.—The sixth congress will be held at The Hague, Holland, commencing July 23, and will continue for six days. The members of the congress will be delegates from governments and delegates accredited from chambers of commerce, railway and navigation companies, and other transportation associations, technical and scientific societies, and other interested persons. The sessions of the congress will comprise general meetings, meetings of sections and excursions. The following subjects will be discussed, and 41 papers have already been received from engineers and others:

Construction of Navigation Canals Affording Operation at High Speed.

Plant and Ports of Navigation.

Means for Preventing Ice Blockades.

Traction and Propulsion upon Canals, Canalized Rivers and Rivers of Natural Flow.

Tolls on Navigable Ways.

Relations Between the Configuration of Rivers and the depths of Their Channels.

Regulation of Rivers at Low Water.

Two excursions are now announced to take place during the week of the Congress, one to Rotterdam and the other to Amsterdam. There will also be three other excursions held after adjournment of the congress, one to the Haarlem Meer and to several places below sea level; one to the new mouth of the Meuse, and the third to the Zuiderzee, the Island of Urk, and the Province of Overyssel.

Membership in this Congress, which carries with it the papers and discussions printed in either French, German or English and the right to take part in the meetings and excursions, can be secured at a cost of $5. Subscriptions may be sent to the Secretary of the American Society of Civil Engineers, 127 East 23d St., New York city.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The summer meeting will be held at Montreal, Can., June 5 to 8, the opening session to be held on Tuesday evening, June 5. The headquarters will be at the Windsor Hotel, and professional sessions will be held at the Engineering Building of McGill University. Excursions have been arranged down the Lachine Rapids to the Lachine Canal, to Ottawa, and to various points of engineering interest about Montreal. The papers announced for the sessions are as follows:

A. K. Mansfield, "Notes on the Theory of Shaft Governors"; Albert F. Hall, "Heat Units and the Specifications for Pumping Engines"; W. H. Bristol, "A New Recording Pressure Gage for Extremely High Ranges of Pressure"; Frank Richards, "A Note on Compressed Air"; A. W. Robinson, "The Relation of the Drawing Office to the Shop in Manufacturing"; R. H. Thurston, "The Theory of the Steam Jacket; Current Practice"; D. S. Jacobus, "Results of Experiments with a 50-HP. Single Non-Condensing Ball & Wood Engine to Determine the Influence of Compression on Water Consumption"; Frank H. Ball, "Cylinder Proportions for Compound Engines, Determined by Their Free Expansion Losses"; F. M. Rites, "A New Method of Compound Steam Distribution"; Jesse M. Smith, "Tests of a Small Electric Railway Plant"; W. S. Aldrich, "Power Losses in the Transmissive Machinery of Central Stations"; M. P. Wood, "Rustless Coatings for Iron and Steel"; Jas. McBride, "Corrosion of Steam Drums"; C. W. Hunt, "A New Mechanical Fluid"; F. R. Hutton, "First Stationary Engines in America"; DeCourcy May, "Cost of an Indicated Horse Power"; Jno. R. Freeman, "A New Form of Canal Waste Weir"; G. W. Bissell, "Effect of Varying the Weight of the Regenerator in a Hot-air Engine"; W. R. Roney, "Mechanical Draft for Boilers"; R. C. Carpenter, "The Saturation Curve as a Reference Line for Indicator Diagrams"; Denton-Jacobus-Rice, "Results of Measurement of the Water Consumption of an Unjacketed 1,600-HP. Compound Harris-Corliss Engine"; F. B. King, "Notes on the Corrosion of a Cast Steel Propeller Blade."

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on April 21 a paper on "The First United States Pneumatic Postal System" was presented by Mr. A. Falkenau, who stated that the year of trial of the first pneumatic system for postal service in the United States had just been completed and the extension of the system for commercial as well as postal service was contemplated. A brief review was given of what had been done in Europe in the way of pneumatic transmission, and the London and Paris systems were more particularly described. In London the tubes were 2¼ and 3-in. lead pipes laid in cast iron pipes for protection. The carriers used in 2¼ tubes were but 1¼-ins. diameter, the remaining space being taken up by packing. Carriers are dispatched singly. First, vacuum alone was used; later, vacuum and compressed air. The tubes used in the continental cities in Europe were wrought iron, the Paris tubes being 2½-ins. diameter. There the carriers are dispatched in trains of six to ten, propelled by a piston. The carriers and tubes were fully described, also the method of locating obstructions in the tubes, and the two methods of laying pipes on the radial and polygonal systems. To give an idea of the extent to which this work is carried in Europe, it was stated that the London system has 42 stations with a total length of 34 miles of tubes. Six engines of an aggregate of 216 HP. constitute the power plant. The Liverpool and Berlin systems were similarly described.

In 1892 the Pneumatic Transit Co., of New Jersey contracted to install the Philadelphia plant. As the size of the tube adopted and laid was 6⅛-ins. diameter, entirely new problems presented themselves. The velocities adopted in all systems is about the same, being 30 miles per hour. The stored energy of a London carrier while at full velocity is only 9 ft.-lbs., while that of the Philadelphia carriers has been as high as 1,380 ft.-lbs. The problems of dealing with this energy were solved by Mr. B. C. Batchellor, the engineer of the company. Air cushions were introduced, the accumulated pressure in the cushion chamber being utilized at the same time to operate automatically the receiving apparatus. The distance from the main postoffice to the sub-station at Chestnut St. is 2,928 ft. There being an outgoing and return tube, the total length is 5,856 ft. The apparatus at the two stations was described in detail. The pressure of air at the main postoffice is 7 lbs., while at the sub-station it is about 4 lbs., as the pressure does not fall at a uniform rate. The air passes through the entire system of tubes, returning to the postoffice at atmospheric pressure, the end of the tube being practically open to the air. The two air-cylinders of the compressor located at the main postoffice are 18-ins. bore, while the steam cylinders are 10-ins. bore with a piston stroke of 24-ins. There has not been a single case of obstruction of the tubes since the plant was first put into operation.

The difficulties encountered in laying the pipes and boring the same were described. The use of air blast in boring reduced the temperature near the cutters from 20° to 40° F. Attention was called to the fact that, mechanically, pneumatic propulsion is not economical, about 90% of the work being wasted. It was pointed out, however, that commercially the value of pneumatic transmission was amply proved and that the larger size of pipe adopted would permit a more remunerative class of business to be done.

It is now proposed to extend the system to cover the greater part of the city, locating the central pumping station about Twelfth and Market Sts., with other central stations at Columbus Ave., South St., etc., the connections being made on the radial system. Each central station will be the nucleus of a number of local polygonal circuits, covering territory within convenient limits. Mr. Falkenau stated that this first pneumatic postal tube in the United States was the largest of its kind in the world.

Mr. W. W. Carr, Postmaster of Philadelphia, stated that the tube has carried 30,000 letters per day, and has been working most satisfactorily and without a single stoppage. Great credit is due Philadelphia for introducing the first pneumatic system in the United States. Chicago and other cities are contemplating following the example. Mr. John Field, ex-postmaster, explained that he felt the need for improvement in the methods of handling the Philadelphia mails as soon as he entered upon his duties as postmaster. He visited European cities to learn the best methods in vogue, and decided to recommend the adoption of a system similar to that in use in Berlin. More or less meritorious designs were offered by different companies, but the greatest difficulty was to obtain the permission of the Government to make the trial. The system finally adopted has proved entirely successful and reflects great credit upon its constructors, as well as its designers.

Mr. W. J. Kelly, President of the Pneumatic Transit Co., described some of the difficulties that he had to contend with. Mr. B. C. Batchellor spoke of the advantages of the present system, citing a case of special delivery, where more than three hours had been saved in transit from Philadelphia to New York. Referring to details, he said that the most economical speed of carrier was about 30 miles per hour, and the actual time the mail was in the tube was but a very small part of the total time in handling. An increase in velocity would add to the wear and tear, with but little gain. This same speed is used in the continental lines. The diameter of the tube was determined only after mature deliberation. The original intention was to use 6-in. wrought iron pipe; but finding the diameters varied too much, 6-in. cast iron water pipes was used, bored out to 6⅛-ins. This capacity has proved ample, and is by far the largest in the world. Each carrier holds about 200 letters, but 100 to 150 should be taken as the average, which, at the rate of eight carriers per minute, gives a delivery of 48,000 letters per hour. The time required to make the distance between the two postoffices is about 57 seconds, and the carriers will run about 550 miles before the packing-rings placed on the outside to form air-tight joints will wear out. This packing was formerly made of felt, but now it is found that canvass answers the purpose very well. The best form of carriers are those with open ends, as this gives a much stronger shape than those with the openings on the side, and there is much less danger of breakage. The largest size of pneumatic tube considered feasible was about eight or ten inches in diameter, as beyond this size the carriers increase so rapidly in weight that the packings, upon which the whole weight rests, would soon wear out. The length of such a line should not exceed four miles. He closed with some interesting conclusions drawn from his experience regarding the advantages and applicability of the polygonal system, giving special reference to the enlargement of the Philadelphia plant.

COMING TECHNICAL MEETINGS.

MONTANA SOCIETY OF CIVIL ENGINEERS.
May 12. Secy., G. O. Foss, Helena.

ENGINEERS' CLUB OF KANSAS CITY.
May 14. Secy., Waterman Stone, Baird Building.

WISCONSIN POLYTECHNIC SOCIETY.
May 14. Secy., M. F. Schinke, City Hall, Milwaukee.

WESTERN RAILWAY CLUB.
May 15. Secy., Clement F. Street, Rookery, Chicago.

COLUMBIAN ENGINEERING SOCIETY.
May 15. Secy., F. W. Hart, Washington, D. C.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
May 15, 18. Annual meeting at Philadelphia. Secy., Ralph W. Pope, 12 W. 31st St., New York City.

BOSTON SOCIETY OF CIVIL ENGINEERS.
May 16. Secy., S. E. Tinkham, 36 Bromfield St.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
May 16. Secy., J. A. Pilcher, Roanoke, Va.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
May 16. Annual meeting at Niagara Falls, June 20. Secy., F. Collingwood, 127 E. 23d St., New York.

ENGINEERS' CLUB OF ST. LOUIS.
May 16. Secy., Wm. H. Bryan, Turner Bldg.

NEW YORK RAILROAD CLUB.
May 17. Secy., John A. Hill, Temple Court.

ENGINEERS' CLUB OF CINCINNATI.
May 17. J. F. Wilson, 24 W. 4th St.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
May 17. Secy., Howard Berge, 100 Washington St.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
May 17. Secy., Daniel Carhart, Carnegie Lib. Bldg., Allegheny.

TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS
May 18. 201 Washington Building.

ENGINEERS' CLUB OF PHILADELPHIA.
May 19. Secy., L. F. Rondinella, 1123 Girard St.

SWEDISH ENGINEERS' CLUB.
May 19. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 106 Randolph St., Chicago. Secy., C. T. Anderson.

DENVER SOCIETY OF CIVIL ENGINEERS.
May 20. Secy., F. E. King, Jacobson Block.

ENGINEERS' CLUB OF MINNEAPOLIS.
May 21. Secy., E. Nexsen, 504 Kasota Block.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
June 1. Secy., E. K. Smoot, 803 Commerce St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
June 1. Secy., O. Von Geldern, 719 Market St., San Francisco.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
June 5, 8. Convention at Montreal, Can. Secy., F. R. Hutton, 12 W. 31st St., New York City.

WESTERN SOCIETY OF ENGINEERS.
June 6. Secy., Thos. Appleton, Lakeside Bldg., Chicago.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
June 12. Secy., F. C. Osborn, Case Library Building.

NORTHWEST RAILWAY CLUB.
June 12. Secy., W. D. Crosman, Ryan Hotel, St. Paul.

NORTHWESTERN SOCIETY OF ENGINEERS.
June 12. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.

MASTER CAR BUILDERS' ASSOCIATION.
June 12, 16. Saratoga, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago.

CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
June 13. Wichita, Kan.

NEW ENGLAND RAILROAD CLUB.
June 13. Secy., F. M. Curtis, P. O. Box 1576, Boston.

ENGINEERING ASSOCIATION OF THE SOUTH.
June 14. Secy., Hunter McDonald, Nashville, Tenn.

ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
June 14. Secy., G. W. Shaw, Norton Building.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 15. Secy., D. W. Meeker, St. Paul.

NEW ENGLAND WATER-WORKS ASSOCIATION.
June 14, 16. Annual convention at Boston. Secy., R. C. P. Coggeshall, New Bedford, Mass.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
June 17. Secy., C. H. McLeod, Montreal, P. Q.

MASTER MECHANICS' ASSOCIATION.
June 19, 23. Saratoga, N. Y. Secy., Angus Sinclair, Temple Court, New York.

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As stated in our issue of March 15, reports have been for some time in circulation that the Canadian Pacific was considering the movement of trains over its Rocky Mountain division by electric power. We are much pleased to be able to announce official confirmation of this report. The portion of the road on which it is proposed to introduce electric traction is the section crossing the Kicking Horse pass. Engineers have been in the field for some time gaging the flow in the streams adjacent to the road, and a report on the project has been made by Dr. Berliner, of the Siemens & Halske Electric Co., of Chicago, after a personal examination of the line. When the question of water supply has been settled it is expected that the project will go forward.

Whether cities should build and own conduits and subways for electric wires is a question which is puzzling a good many legislators, economists and engineers. On the one hand it is urged that it was bad enough to have rival telegraph and electric light companies multiplying poles and overhead wires in city streets, and that it is out of the question to permit the needless destruction of pavements and the crowding of the space underground which would result if each electrical company were to set to work to build its own underground conduits. On the other hand, it is argued that further developments in electricity may at any time make obsolete a system of underground conduits, and that such an investment, therefore, should not be made by a municipality. But the advocate of municipal ownership replies that admitting this to be true, it is rather hard on the owners of the electric plants. They were permitted and encouraged to build extensive plants and invest their money in poles and overhead wires when no one thought of distributing electricity underground. The city now steps in and says that the poles and wires must go. The owners of the electric plants are confronted with the alternative of losing all they have invested or of building expensive underground conduits which, according to the above claim, are liable also to prove a dead loss at any time. Certainly in equity if the city in its dealings with the company requires it to assume risks that were not contemplated when the bargain was made, then the city should at least share such risks with the company.

There appear to be two methods by which the problem may be solved with substantial fairness to all parties. By the first method the city grants to an independent company the monopoly of subway construction and operation, requiring the company to furnish equal facilities to all electrical companies desiring to lay wires in its conduits, and limiting its rates for rental to such an amount as will cover interest, depreciation, profit and a fair allowance for the risk of the subways being superseded by advancement in the art. By the second method, the city itself assumes the ownership and control of the subways and fixes its rentals by the rule above laid down. By either method, it will be seen that the most important requirement, that the city should retain sole control of its street surface and the space above and below it, is effectually secured: and the needless duplication of subways is prevented.

We give in another column a summary of the recommendations of the several railway clubs with respect to the amendment of the rules which govern the interchange of freight cars between different railways. About the usual number of changes in the rules are proposed, and the few which are really of importance are likely to be overlooked in the number of petty changes which have been recommended. Doubtless the rule on which action is most needed is that which would limit the permissible variation in the gage of car wheels to ¼ in., in place of the present broad variation of ¾ in., which was adopted many years ago to provide for cars running over all gages of track, from 4 ft. 8½ ins. to 4 ft. 9 ins. No one denies that ½-in. variation is more than ample to cover inaccuracies in mounting wheels on axles; and it has been conclusively shown that the present wide limits (now that practically all track has been changed to the standard 4 ft. 8½ ins. gage) are exceedingly destructive to frogs and guard rails, and probably lie at the bottom of a good share of the "unexplained" derailments at switches. The only opposition to the change arises from those who fear that the number of cars now running with wheels wide or narrow gaged in excess of these new limits would be so great as to cause delays to traffic and heavy bills of expense. If this is the case, however, it is all the more reason why action should be taken. The fault must be remedied sooner or later, in the interest of the safety of passenger trains as well as freight trains, and it will cost no more this year than next year. It seems probable, moreover, that the number of cars with wheels out of gage is by no means in proportion to the amount of damage done by them, and that the saving in maintenance of frogs and guard rails will soon compensate for the expense in remounting these badly gaged wheels.

Other proposed changes in the rules, which are given in another column, need not be discussed here, save to say that the impression grows stronger, year by year, that the whole system of car interchange, with all its complicated laws and rules and traditions, is merely a temporary expedient which is serving its purpose as well at present as anything which could be devised; but which must eventually be succeeded by a system of common ownership of all freight rolling stock interchanged between different roads. When this arrives, all the haggling over petty points of difference, and the everlasting attempt to devise rules which will control the company that ardently desires to get a little more than its just due in dealing with its neighbor company, will be at an end. Such a common ownership of freight cars, coupled with the adoption of and adherence to common sense standards, would lessen the cost of freight car repairs by an enormous amount and would vastly simplify the settlement of the vexed questions of car mileage, privately owned cars, and many other problems which now perplex railway managers.

The water supply problem in some parts of New Jersey is growing more and more serious with the rapid increase in the population of the large cities and of some of the smaller suburbs remote from plentiful or pure water supplies and with the acquirement of the main water supplies by syndicates, often for speculative purposes only. Because of the long supply mains required, it is practically out of the question for the small towns, individually, to secure water from the most desirable sources and hence comprehensive schemes for the common supply of several municipalities have been carried out in several instances within a radius of 25 miles from New York, some of which, however, have been arrangements of convenience rather than to secure a pure water supply. Thus the Hackensack Water Co. supplies Hoboken and a large number of villages and towns to the north and west; Jersey City supplies the abominable Passaic River water to some of the towns adjoining it; from the works of the East Jersey Water Co., forming the new supply of Newark, more or less water is supplied to some of the suburbs on the west of Newark; and from the driven wells of the Plainfield Water Supply Co. water is distributed to a number of surrounding villages and towns.

The conditions outlined above have suggested from time to time the desirability of state water supply systems, meaning thereby general supply works as distinguished from distribution systems within the municipalities. In 1882 a state water supply commission was appointed and later made some general investigations along the lines suggested above, but owing to antagonism, apparently, from parties interested in private water rights the work of the commission was not carried far. In the past two or three years attempts have been made in the New Jersey legislature to rehabilitate the state water board and an elaborate bill is now before both houses of the legislature ("Senate, No. 42") to that end. In general certain drainage areas of the state would by this bill be put under the charge of a commission of five, four to be appointed by the governor, and a hydraulic engineer, constituting a fifth member, to be chosen by these four, the members to hold office during good behavior. Any municipality desiring water from these reserved drainage areas would so inform the board, whereupon plans for supplying it would be made and estimates submitted to the municipality, which would then by popular vote decide whether to contract with the state for water. If the decision should be favorable, the supply would be brought to the boundary line of the town or to some other convenient point and the town would pay annually for the water used at an agreed rate per million gallons, which rate would represent only the actual cost of bringing the water to the municipality, together with interest charges and a sum for a sinking fund. The act contemplates the supply of a number of towns from one system, each town to pay its proper part of the whole.

Naturally this bill is being vigorously opposed by the large water companies and syndicates owning water rights; and as the officials of these companies are intimately connected with politicians of both parties it would not be surprising if the bill were killed. The problems involved are of vital interest to the people of New Jersey and should be studied until a permanent and equitable solution is reached.

THE REDUCTION IN COST OF FIREPROOF CONSTRUCTION.

We alluded recently to the effect of the present era of low prices in upsetting accepted ideas and customs in engineering practice and instanced the economy of fireproof construction (as compared with fire-trap construction), this economy having been brought about by the unprecedented reduction in prices of steel beams and of fireproofing materials. We are now able to present an interesting illustration of the cheapness of fireproof construction at the present time.

A few weeks ago a firm of architects in Philadelphia were preparing plans for a large building, the estimated cost of which was about $125,000. Nothing but ordinary lath-and-plaster construction was contemplated, the firm in charge of the work taking it for granted that now, as in former days, fireproof construction was a luxury only to be afforded on sky-scraper office buildings. The representative of a manufacturer of clay products called on the firm and urged them to get estimates on both fireproof construction and wooden construction before letting contracts for the latter.

After some demurring they finally consented to do this and were no little surprised to find that the fireproof construction involved an expense only $4,500 greater than the ordinary construction, or an increase of only 3.6 per cent. in the cost of the building.

The interest on this increased investment at 5

per cent. amounts to 0.18 per cent. of the total cost of the building; thus it is seen that a saving in annual insurance rates of only $1.80 on $1,000 insured would pay the interest on the increase of cost due to the adoption of fireproof construction.

It is doubtless true that outside of the large cities the difference in cost between fireproof and wood construction is considerably greater than in the case cited above. This is chiefly due to the lack of experience with such construction except by large firms of contractors and builders. This will rapidly disappear, and apparently the time is close at hand when nearly all structures erected for mercantile or manufacturing purposes, except of the very rudest description, will be made of fireproof construction. The same will be true of all city dwellings; indeed, a substantial beginning has already been made, and among residences for which contracts have recently been let are not only the palatial houses of some wealthy men, but dwellings for people of moderate means.

From an engineering standpoint, one of the most important results of this revolution in the cost of fireproof construction is the possibility it offers of relieving certain classes of manufacturing industries whose fire risks have long made their insurance rates a heavy burden. It is of interest to note in this connection that the fall in prices of the past two years has probably wiped out the margin which has existed between the first cost of slow-burning construction and that of regular fireproof work. The slow-burning construction has met a great need in the New England textile mills, and those who have developed it are deserving of great credit. Superiority in some other respects may cause it to maintain a certain hold for some years to come; but in general it seems probable that better results will be secured by combining good fireproof work with it, and that for especially risky locations, like picker-rooms, etc., absolutely incombustible construction will have the preference.

The owners of electric light and power stations have long complained that the rates charged them by the underwriters were far in excess of the actual risk. Whatever there may be in this claim, as respects the better built class of stations, it is unfortunately true that fires in such stations have been frequent and disastrous. The reason appears to be that in the majority of cases electric light and power plants have been housed in ordinary buildings originally built for other purposes, and making no pretence to fireproof construction; or where a new building has been erected, cheapness in first cost has been the chief aim of the builders. The electrical industry is fortunately situated with respect to protection from fire, inasmuch as its plant and materials are not combustible; and it only needs to be housed in incombustible structures to be able to snap its fingers at the devouring element, and at the insurance companies, too, if it chooses.

It is to be remembered in discussing this matter, and in considering the relative cost of fireproof construction and the old systems which it is to displace, that fire insurance seldom covers the actual loss sustained, direct and indirect. The interruption to business, the trouble due to the destruction of valuable papers, drawings, records, patterns, templates, gages, the risk to human life, and the liability of employers for death and injuries sustained by workmen in fighting fires—these are among the things to be taken into consideration when the question of fireproof construction for a factory building is to be decided.

Another thing will suggest itself to many thoughtful men in these times of frequent labor troubles; that is, the danger of fire from incendiarism. It is generally conceded that where a company can afford to do so, it is far better to assume its own risks of fire than to attempt to carry insurance. An insurance company is simply an organization by which losses are averaged up, and in the long run the owner of property must pay his own losses, plus the operating cost and profits of the insurance companies. Hence a great railway corporation, for example, will inevitably profit in the long run by doing its own insuring. But the property of railways and manufacturing corporations is especially likely to be the subject of incendiarism in times of labor troubles, especially if it is of such a character that it can be fired without exciting suspicion. For this reason especially, corporations which carry their own insurance should adopt fireproof construction.

In dwelling construction the risk to human life and to heirlooms, keepsakes and art treasures—things prized at a value above their mere price in money—should be strong motives in influencing the adoption of fireproof construction. The destruction to human life which comes in this way occurs for the most part in such scattered instances that the extent of the risk is little realized. According to Mulhall, 1,390 persons are killed by fires annually in England and Wales. Every habitual reader of newspapers knows how frequent is the record of loss of life by fire; yet it is only when some such case happens as the burning of General Tracy's house at Washington some years ago, or some tenement house holocaust in a great city causes reporters of the Metropolitan dailies to vie with each other in securing details, that an impression of the risk to life due to the common fire-trap methods of construction is made upon the public.

Again, it is to be remembered that the fire-risk is not the only defect of the common wood construction. The life of a wooden house is limited in any event. Dry rot threatens its floor beams, a notable example being the collapse of ex-Vice-President Morton's palatial hotel in Washington a few years ago. Summer's heat and winter's cold and the alternating effects of dampness and drought gradually pull it to pieces. This is especially true of the modern frame house with its light scantlings. The old wooden colonial houses, some few of which still endure, were made with far heavier timbers and could better withstand the "gnawing tooth of time." A properly built fireproof building of steel and terra-cotta, on the other hand, is a permanent structure, and no such large sum must be written down against it for "depreciation and repairs" as must be done with a wooden house.

Of course it is not to be denied that the wood construction has served a valuable purpose. It has made possible the comfortable housing of the inhabitants of this country at a first cost vastly less than could have been possible had our builders used the materials and followed the customs of continental Europe in their work. But a new set of conditions confronts us. Iron, terra-cotta and concrete are produced by our mills at a phenomenally low cost and they are to be the building materials of the future. So fast as these new conditions are realized, so rapidly will the market of our iron and steel manufacturers and our makers of clay products expand. Coupled with this, perhaps, will be some reduction in the waste of our forestry resources, whose rapid diminution is exciting well-grounded alarm among those who look to the welfare of succeeding generations.

The reduction in the fire tax which will result in time as better construction replaces the old, will be a factor of great importance. Fire losses in the United States now exceed $150,000,000 per annum, a sum whose magnitude can be somewhat appreciated by saying it is equal to half the total passenger earnings of the railways of the United States. Such a serious burden upon the commerce and industry of a country can only be compared to the taxes assessed by European countries for maintaining their armaments. It is greatly to be hoped that the revolution in construction which is apparently before us may proceed rapidly enough to at least prevent further growth of the nation's annual fire loss.

LETTERS TO THE EDITOR.

STOPPAGE OF AN 8-IN. SEWER BY WORMS.

Sir: Last Monday the 8-in. sanitary sewer on Fair St., in this city, was reported stopped up. The superintendent of sewers tried to flush the obstruction through the sewer, but was unable to do so. It was approximately located and the sewer opened, when, to the surprise of all, the stoppage was found to be worms. For about 10 ft. in length the sewer was solidly full. A 1¼-in. gas pipe could not be pushed through the obstruction, and it was necessary to take up each pipe and clean the same. I send you a sample by this same mail, and would request you to inform me if many such cases have been reported, and if it is known from what cause these worms come. Within 300 ft. of the stoppage is a flush tank. On March 6 a thorough inspection of the system was made and four flushes were sent through this sewer. At that time it was clean. These worms have come since then.

Elw. B. Codwise, City Engineer.

Kingston, N. Y., May 4, 1894.

(We do not recall and can find no records of a similar instance of stoppage and, from the information at hand, can give no explanation of the cause. The sample referred to as sent to this office consists of a small bottle containing a half liquid filamentous mass, the filaments being white, giving no sign of life, and possibly being of vegetable origin, so far as appearance is concerned. Fermentation had been going on in the bottle before it was received, which may have changed the character of its contents. In the bottle the filaments appear to be 1-32 in. in diameter and perhaps ¼ to ½ in. in length, with occasional changes in shape which might be in the nature of heads or enlargement of bodies. Have any of our readers known of similar obstructions in sewers?—Ed.)

BRICK AND MACADAM PAVING.

Sir: I notice in your issue of April 19 the statement that the city of Freeport, Ill., after a trial of brick pavement has contracted for macadam, giving the inference that brick pavement has proved unsatisfactory in that city. Freeport has as yet laid no brick pavement, and the only reason for adopting macadam has been on account of the low first cost of macadamized streets. In a recent letter on this subject from Mr. Arthur Lagron, City Engineer of Freeport, Mr. Lagron writes: "There is no brick pavement in Freeport; hence no judgment has been asked upon its merit. On the contrary, the City Council and myself have made thorough investigations, and we believe it to be the best and most durable mode of improving streets; but as we own a quarry, a crusher and a steam roller, our citizens prefer macadam on streets with light traffic on account of its comparatively small cost."

The city of Dubuque, Ia., has a small amount of brick pavement on its main street, and I understand contemplates improving the balance of the streets with macadam. The principal reason for this seems to be that the city of Dubuque is surrounded by limestone bluffs which make the cost of macadamized streets comparatively low, and the quarry interests comparatively strong. I know of no other cities in the West where brick pavement has been tried without proving entirely satisfactory. Yours very truly,

Daniel W. Mead, Engr. of Municipal Pub. Works.

Rockford, Ill., April 28, 1894.

ADJUSTING COMPASS ZEROS ON TRANSITS.

Sir: In your issue of March 22 (p. 241) I was especially interested in the letter of Mr. L. C. James concerning some transit adjustments. I had noticed for a long time the difference of the magnetic bearing of different instruments on the same line, and wondered why it should be, never supposing the instrument-maker would allow a transit to leave his place without setting the compass zeros in the plane of collimation as perfectly as any other adjustment.

I tried Mr. James' plan by using an auxiliary transit, and found that my transit registered 3' too much. I then tested the auxiliary in the same way and found that it registered 8' too little, making a difference between the two transits of 11'. This may appear small, but it annoyed me considerably in trying to get the true declination of the needle, after having established a true north and south line, as has been done in some other states.

I believe with Mr. James that this is an adjustment which surveyors seldom think of, and I fail to see how we can do good work in this line or make good records, unless the compass zeros are in the plane of collimation, and I hope that instrument-makers will do better in future. Respectfully,

W. H. Tinker, City Engineer.

Coronado, Cal., April 5, 1894.

THE PEORIA STAND-PIPE FAILURE.

Sir: In addition to what has already been written regarding the Peoria stand-pipe failure, there are a few facts and observations which it may be well to consider. Let us first observe a few of the facts:

(1) On Jan. 5, 1894, by observations made with a transit instrument, I found that the tower leaned some three or four inches toward the northeast. People living in the neighborhood testify that when filled the water always ran over on the northeast side.

(2) The wind from the southwest, according to my estimate, at the time, was blowing about 30 miles an hour. Possibly this is a high estimate, but I feel certain the velocity was above 20 miles per hour. The temperature in the shade was about 58° and in the sun about 66° F., the sun being dimmed by thin, hazy clouds.

(3) The failure occurred immediately after the pipe

had been subjected to vibrations caused by workmen calking leaks.

(4) In all cases the failure of the steel was short and brittle. In many places it cracked in a manner reminding one of broken plate glass. (Some of these fractures are shown in photographs taken by the writer and reproduced in Engineering News, of April 26, 1894). The fractures were always crystalline, usually of rather fine structure, in some cases resembling that of drill steel. Numerous checks and cracks radiate from the rivet-holes showing that the metal was too brittle to be punched without injury.

(5) The fractures were as often through the solid plate as along the riveted seams, and rivets were sheared in only a few instances.

Interest therefore centers in the report of the physical and chemical tests made by Messrs R. W. Hunt & Co., of Chicago, published in Engineering News of April 26, 1894. With these facts before us we do not have far to seek for the causes of the catastrophe.

Noting the physical tests, the metal shows inferiority in both the elongation and percentage of reduction, especially the latter. The chemical analysis clearly shows the reason for this, as the phosphorus contained is nearly double that allowable in high grade steel plate. While the percentage of sulphur is rather high, the carbon is low, and the stand-pipe probably would never have stood the first filling had it not been for the fact that the carbon and phosphorus were associated with a fair percentage of manganese.

This failure, therefore, opens again the question of the proper metal for such work. Since most of the accidents of late have been in steel, some favor a return to the use of iron. One of two propositions is certain: (1) The fault is inherent in the metal, steel not being suitable for this purpose, or (2) the proper kind of steel is not used. The circumstances in this instance do not seem to point to faulty design or bad construction. Those favoring the rejection of steel attribute the failure to the first assumption; I think the latter affords the true explanation.

There is danger of placing too much reliance in the physical tests usually applied, particularly the tensile strength and elastic limit. Since steel plates seldom if ever break because the tensile limit has been exceeded the percentage of elongation and reduction of area, particularly the latter, seem to be the more reliable criterion of a metal's fitness. If to these requirements the punching, shearing and bending tests are added it is usually supposed that the necessary knowledge of the metals' behavior in the finished structure will be known.

Is this true? Do these tests adequately represent the multitude of stresses endured by the metal in the finished work? I think not. Imperfect workmanship, eccentric bearings, vibrations from wind impulses, expansion and contraction strains, ice expansion and adhesion, water hammer, confined air pressure, and a hundred other unknown and unknowable stresses require that the metal shall have such internal molecular tension and arrangement as shall enable it to withstand this added work. Since the chemical composition is the determining factor of this molecular quality, if to the physical tests be added the proper restrictions regarding the chemical impurities contained, I believe steel to be a more safe and trustworthy metal than wrought iron.

Any engineer who reads the array of charges against phosphorus as made by Henry M. Howe in his "Metallurgy of Steel" will be convinced that this lurking enemy must be kept within certain limits. Owing to the insidious nature of this element its exact effect cannot be predicted. The same metal in one instance will endure a violent strain and then fail when least expected. With gently applied loads, as tensile tests are usually made, it will often show good results, yet this same steel will fail under sudden shock or vibratory motion. The very fact, therefore, that some metal high in phosphorus gives good physical tests is the strongest reason against its use. On the other hand, other things being equal, iron and steel low in phosphorus show no such erratic tendencies. A brief quotation will suffice to enforce this point. Mr. Howe says:

> Phosphorus probably has little effect on tensile strength under gently applied load, but phosphoric iron is readily broken by jerky, shock-like or vibratory stresses, sometimes when quite trifling;—it is treacherous. It sometimes affects iron but slightly, sometimes under apparently like conditions profoundly;—it is capricious. . . . If any relation between composition and physical properties is established by experience, it is that of phosphorus making steel brittle under shock.*

Another point which suggests itself, although I know of no experiments bearing directly upon it, relates to the fatigue of the metal. The effect of phosphorus in making steel crystallize is well known. It is also a well established fact that when a substance is on the point of nascent crystallization the formation of the crystals is greatly hastened by slight shock or vibration. Is it, therefore, unreasonable to suppose that the joint effect of these two properties would make a metal high in phosphorus tend to develop the crystalline structure under vibrating stress with greater rapidity than one low in phosphorus and not having so strong a tendency to crystallize?

If in the Peoria case, as the owners of the wrecked pipe believe, the metal had become weakened by the strains from ice, winds, changes of temperature, etc., it was probably hastened by the large percentage of phosphorus (0.136%) contained.

It would be of value to the profession if chemical analyses were available of the metal of the various stand-pipes that have failed from apparently faulty steel. Possibly by search and correspondence samples of several at least could be obtained. It would afford some advanced metallurgical student a good opportunity to throw light upon a vexed question.

In the light of past experience with the use of iron and steel for stand-pipes, it seems apparent that a change of methods of stand-pipe engineering is absolutely demanded. Engineers cannot afford to imperil the lives and property of those dependent upon their skill by considering the convenience or interests of rolling mills, inspectors, or constructing contractors. Both material and workmanship must be the best obtainable. If rigidly inspected both at the mill and during erection by competent and faithful inspectors, with soft steel, say, not over 62,000 lbs. tensile strength, with a maximum of about 0.15% carbon and 0.08% phosphorus and with the appropriate physical requirements, I believe steel can yet be safely relied upon in stand-pipe construction.

W. C. Parmley.

Peoria, Ill., April 28, 1894.

(The addition of a phosphorus limit to the physical requirements in specifications for structural steel is favored by many engineers. Concerning the suggestion that greater attention should be paid to the reduction of area in tensile tests, it should be said that some engineers oppose too great reduction of area, claiming that it indicates a steel which will fail like copper under repeated moderate impact, its elastic limit being so objectionably low that it will gradually stretch. (See Eng. News, June 20, 1891.) It is true, that a high percentage of reduction of area is an indication of the ductility of the metal; but what is wanted in structural steel, especially if punching is to be permitted, are toughness, resilience and ability to resist abuse without injury, qualities which are similar to, but not quite identical with, ductility. Bending and nicked-bending tests, made with a sledge, and the drifting test are excellent methods of testing the quality of steel in addition to the regular tensile tests, and are pretty sure to tell the story of brittleness or toughness, as the case may be.—Ed.)

* "The Metallurgy of Steel," pp. 54 and 68.

ORGANIZATION AND MANAGEMENT OF ENGINEERING SCHOOLS.

Sir: In view of your continued interest in the uplifting of technical training in the United States, I am tempted to ask a hearing upon one of the yet unsettled problems.

One of the most vital questions concerning the educational usefulness of an institution of learning is the maintenance of a just balance between individuality and cosmopolitanism. The first is favored by training a special corps of instructors made up of alumni; the second end is attained by drawing upon the graduates of other institutions. These two policies are diametrically opposite in their effects; and an institution which pursues either tendency to an extreme is likely to suffer from dry rot, or water, as the case may be. The difficulty is somewhat aggravated, moreover, in the case of a great technical school by the difference between the theory of teaching and the practice of actual professional experience. Criticisms are always rife among those who do not consider the problem carefully; directed especially against the evil effects of so-called theoretical training. Thus, a third element has to be drawn upon to supply the instructing corps, namely, those who, whether graduates of the institution and trained in its methods, or brought with new ideas from rival schools, have had the benefit of a practical professional career. Probably every one of the great technical training schools in this country has felt this difficulty of reconciling theory with practice; and still criticisms appear from many sources, claiming that the problem is not yet solved. In the hope of shedding some light upon the question, it may be of interest to indicate the way in which the administration of the Massachusetts Institute of Technology, the largest, and one of the oldest scientific schools in this country, has sought to remedy the evils of so-called theoretical scientific education. It has been the expressed policy of President Francis A. Walker to avoid the evils of "in-breeding" by drawing upon the graduates from other professional schools of equal standing to a considerable extent. The faculty at present includes three graduates of the Sheffield Scientific School, three or four from Johns Hopkins, four from Harvard, two from Bowdoin College, and others from the University of Virginia, the University of Liege, the University of Vermont, the Industrial University of Illinois, etc., etc.

On the other hand, the maintenance of the traditions of the school and the preservation of its own peculiar character have been secured by a careful selection of assistants from its graduate body. It is justly held, it seems to me, that the aims and methods, ingrained during the plastic period of undergraduate work, and developed by foreign and maturer training, must necessarily give coherence to its faculty and its instruction, which could be attained in no other way. The necessity of graduate study in Europe or elsewhere is, however, recognized, and a permanent European colony of graduate students preparing to return to the institute has been the rule in recent years.

We have next to deal with the most difficult task, the reconciliation of theory and practice. This is to be attained in three ways: First, by the presence of men of note in their several professions on the board of trustees and visiting committees; secondly, by the selection of teachers who have had a practical professional experience; and, thirdly, by the selection of lecturers who shall bring the students into close relations with men who are engaged in actual work in the field. A word as to each of these:

The board of trustees of an institution may be a safeguard against academic insularity, for the inspiration which comes from the close supervision of its visiting committees cannot be overestimated. Our department of civil engineering, for instance, for twenty-five years enjoyed the continuous interest and attention of the late Jas. B. Francis, one of the most eminent engineers of this country. The visiting committee upon the department of mechanical engineering has been under the chairmanship of Mr. Hiram F. Mills, than whom there is no more able representative of his profession in America, while Mr. Francis Blake, inventor of the telephone transmitter, and long connected with the Coast Survey, is chairman of the Committee on Physics and Electrical Engineering. Among others who may be mentioned are Mr. Howard Carson, chief engineer of the Metropolitan Sewage Commission; Col. Thomas L. Livermore, the general manager of the great Calumet and Hecla Mining Co., and Gen. Chas. J. Paine, of international nautical fame, who is chairman of the Committee on Naval Architecture. In every department the attempt has been made to insure a close touch with practical affairs by the presence of men of professional eminence and not mere men of wealth in the corporation.

In the second place, those who actually accomplish the work of instruction are, as a rule, men who have been eminent in practical affairs, as well as in educational work. Yet the main point to notice, and here I quote from the President's words, is that "engineering education is not primarily an engineering problem, but an educational problem; and in the case of three-fourths of the teachers of a school, it is of indefinitely more importance that they should be good teachers than that they should have had professional experience. The great work of a school like this is teaching; its great need is that of good teachers." Nevertheless, most of our faculty have been identified with practical affairs. The head of the Department of Civil Engineering has been for several years the expert engineer of the Railway Commissioners of Massachusetts, and is one of the three Subway Commissioners for the city of Boston at the present time. The Professor of Railroad Engineering has been for ten years in railroad work in the far West; the Professor of Surveying has had ten years' experience on the United States Coast Survey. The fact is that a lifetime's experience in a profession is no qualification for teaching—there should be just enough of it to insure a check upon theoretical results; beyond this point, 10 years' service in the field is often better than 25 years for the teacher's purpose. Too long a practical experience tends to dwarf the necessary theoretical side of the teacher's work. For the student must have a glimpse of the wider field before the grind of life begins, else will the dead walls of commonplace routine bar the path of scientific progress. Theory in the technical instruction is as necessary as is a high ideal in the mind of the sociologist or the statesman.

That this double result may be secured, the head of the Department of Chemistry is a man who served 11 years as the secretary of the American Institute of Mining Engineers; the late Professor Norton was for many years the chief chemist of the Amoskeag Mills at Manchester; all of the professors in the mining department have either served a time in the field in Europe or in America; the head of the department having invented several practical mining and ore dressing machines. The Chief of the Mechanical Engineering Department has been called in repeatedly as an expert by railroad officials and railroad commissions, and has performed "the most extensive series of ex-

periments in engineering and applied mechanics which can to-day be credited to any one man"; the head of the course in Biology is the bacteriologist of the State Board of Health, having performed brilliant work in that capacity; the head of the course in Naval Architecture has been appointed by the Secretary of the Treasury chairman of the commission to examine and report upon improvements in life-saving apparatus. The department of General Studies has been represented by its chief in several statistical investigations for the New York and Massachusetts State Boards of Education, and Charities and Correction. These are but a few of the many examples which might be given to show how intimate is the relation which may exist between a great technical school and the world at large.

The third safeguard against pure academic work is secured by the presence of a large number of special lecturers, who supplement the regular instructing force. They serve to shake the student out of the habitual rut; and the strength and freshness of their work cannot but stimulate the student body in every way. About twenty-five of these experts are now upon our lists, and the number augments each year with the increasing specialization of each industry. It is one of the advantages of a situation in the midst of a great manufacturing community. And not only does the practice come to the halls of instruction, but the students are also led to make excursions into the field of practice. During the present term several tons of apparatus have been shipped to various places in New England and the Middle States for use in practical experimentation from the department of Mechanical Engineering alone.

It is by the use of such means as these that the faculty of a training school should seek to avoid that pedantic spirit which has brought deserved criticism in too many cases upon industrial training in this country. It will surely have a wider popular support when the extent and character of its work are more perfectly realized.

William Z. Ripley.

Massachusetts Institute of Technology, Boston, Mass., April 14, 1894.

(Our correspondent's letter raises a number of very large questions, which have been in part previously discussed in these columns, and which we will not now attempt to discuss over again further than to call attention to one striking fact: chusetts Institute of Technology is "one of the oldest scientific schools in this country," and yet it did not graduate its first class until 1868, or only 26 years ago. It would be strange, indeed, if a whole new department of advanced educational work could spring into prominence within so brief a period as this, and be in all respects as perfectly adapted to its work as the older types of professional schools which have been developed by the experience of centuries. We know of none of these older schools in which it is held that "too long a practical experience tends to dwarf the necessary theoretical side of the teacher's work." On the contrary, in these schools the effort is to confine the whole work of instruction, so far as possible, to the oldest and most eminent practitioners. It by no means follows that the same thing should be done in engineering, but the presumption is that the future tendency will be in that direction.—Ed.)

NOTES AND QUERIES.

A. E. A. asks whether there is any process other than the common method of scraping by which an iron or steel bridge, badly corroded by locomotive gases, can be thoroughly cleaned preparatory to repainting.

S. B. McK. inquires whether any one has ever made brick laid in Portland cement impervious to water under a head of 400 ft. or more. He is unable to find any instances of waterproofing of such masonry except under moderate heads, and wants to build a mine dam which will sustain without leakage a pressure of 12 to 13 tons per sq. ft.

T. H., Tyler, Tex., asks: "What is the best method of constructing a cheap and serviceable country road or driveway under the following conditions and with the materials named? The road-bed is composed of coarse sand through which water percolates rapidly. The materials on hand are iron rock or ore and a very tenacious quality of clay."

D. & K. Lehighton, Pa., ask where charts showing the magnetic declination for different portions of the country can be obtained? Address the U. S. Coast and Geodetic Survey, Washington, D. C. Tables of magnetic declination are given in most works on surveying.

G. S. M., Poughkeepsie, N. Y., should consult any civil engineer for an answer to his queries.

STAND-PIPE ACCIDENTS AND FAILURES.*

By Prof. Wm. D. Pence.

(Continued from p. 359.)

Maryville, Mo., Feb. 28, 1893.

On Feb. 28, 1893, at 12:10 p. m., the 18½ × 135-ft. steel stand-pipe at Maryville, Mo., burst and fell. The severe weather during a few weeks preceding the accident had caused the formation within the stand-pipe of an immense body of ice in the form of a tube, the thickness of whose walls ranged from 2½ ft. at the bottom to 4 ft. near the top. The accumulation was greatest some 30 ft. from the top, at about the average line of the daily fluctuations in the water-level. The temperature, which had risen some 60° several days previous, fell suddenly on the evening preceding the accident to +8° F., but rose again so rapidly during the morning of the day of the accident that thawing was in progress before noon-time. The water level at the time of the failure was said to be 100 ft. above the base, which was equivalent to about 85,000 gallons, the average reduced diameter being taken at 12 ft. It was estimated that a fresh supply of 80,000 to 100,000 gallons per day was pumped into the stand-pipe, which was believed to be sufficient to prevent freezing on the water surface. However, pumping was not in progress at the time of the failure.

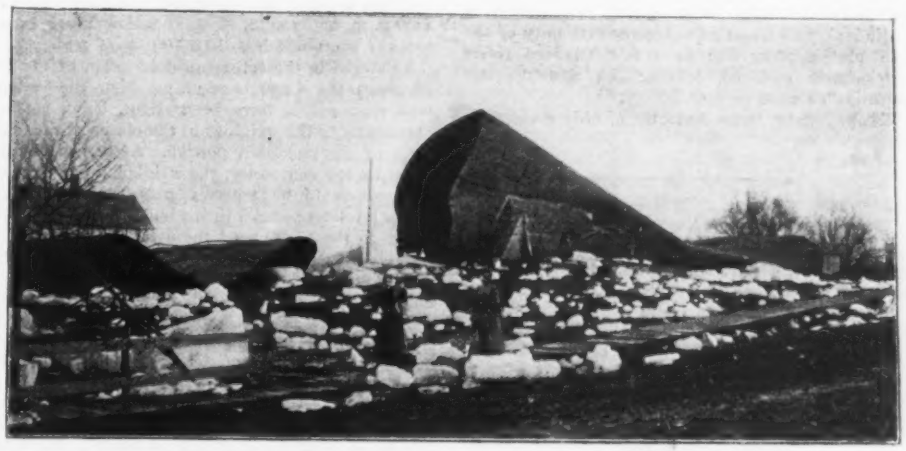

FIG. 12. VIEW OF COLLAPSED STAND-PIPE AT MARYVILLE, MO., LOOKING SOUTHWEST.

The stand-pipe was constructed of "best quality" steel plates varying in thickness from 13-16 to 5-16 in. It was anchored to a substantial foundation by means of eight pairs of 2-in. bolts attached to plate brackets which reached to the top of the second course of plates. The 10-in. inlet pipe was located on the south side. Having been completed in July, 1886, six winters, more or less severe in character, had been passed through without the development of visible signs of weakness.

After the failure, the foundation and the bed-plate, with a portion of the three lower courses and the attached anchorage, as is rather dimly shown in the view, Fig. 12, were found undisturbed. The remainder of the stand-pipe separated into two portions, as shown in Fig. 12, a lower section of 50 ft. being carried 100 ft. northward, and the upper 85 ft. falling to the southward after first striking the undisturbed fragment of the lower plates. The lower section was split in a nearly vertical line from end to end upon what had been the south side of the stand-pipe, and the lower plates of the longer section were torn and bent by the force of the fall. Wherever brackets were torn away the anchor bolts were sheared off and the inlet pipe with its connections, weighing a half ton, was projected 100 ft. southward, partly demolishing a building.

As to the method and cause of the failure, nothing definite was agreed upon at the time, except that the existence of the ice in the stand-pipe had, in some unknown manner, led to its destruction. However, a careful study of all available facts and a comparison with previous accidents occurring under similar conditions suggest the following explanations:

During the formation of the ice walls the thickness was doubtless greater upon the north than upon the south side of the stand-pipe, and this difference in thickness was probably materially increased during the several days of higher temperature which preceded the accident. Moreover, during the latter period the influx of freshly pumped water must have melted the ice for some distance above the base, and it is not improbable that the entire body of ice had been thawed loose from the metal shell through the influence of the solar heat, so that with the stand-pipe nearly or quite full, the mass of ice would be buoyed up against or perhaps slightly above the top stiffening angle. With these conditions existing on the evening preceding the failure, the small consumption of water during the night might easily have permitted the ice-tube to freeze fast in the above described position with the excessive fall in temperature. The melting loose under the reversed conditions of the following morning was a natural consequence, and, had the stand-pipe been full or nearly so, no signs of it would have been revealed. However, if the enormous energy stored in the suspended mass of ice (weighing probably not far from 1,000,000 lbs.) be considered in connection with the height of the water at the time of the accident (about 35 ft. below the top), the strains due to the fall above described would seem amply severe to cause the destruction of the stand-pipe. The initial rupture upon the south side might have been due either to the decreased thickness of the ice or to the blowing out of the inlet pipe connection.

This accident strikingly develops the fact that no positive assurance of immunity from ice accidents exists in the mere survival of any number of severe winters, but that the real danger occurs with the succession of extreme conditions about as above described, in connection with a stand-pipe partly empty at the critical moment.

(Since writing the above discussion of cause, careful consideration has been given to the excess in the rate of expansion of ice over that of steel, but a more thorough inquiry into the local temperature records at and immediately preceding the time of the Maryville accident fails to disclose a range of temperature sufficient to warrant the acceptance of the heat expansion theory in this case. The additional facts thus collected are in full accord with the theory of falling ice as above advanced.

The investigation above referred to has developed some interesting points concerning the possible strains in the inclosing metal shell due to the expansion of the ice tube. These points will be given in the final discussion in connection with a brief summary of the several ways in which ice may be a source of danger to stand-pipes.)

References.—Maryville "Democrat," Feb. 28, 1893. Engineering News, Vol. XXIX., pp. 217, 294 (March 9, 30, 1893). Engineering Record, Vol. XXVII., p. 353 (April 1, 1893). Correspondence with the superintendent of the Maryville Water Co. (1893). Correspondence in 1894 with: The Chief of the Weather Bureau, Washington, D. C.; local observers at Clarinda, Ia., and at Columbia, Carrollton, Gallatin, Bethany, Conception and Pickering, Mo. (the last two being within a few miles of Maryville).

East Providence, R. I., Sept. 7, 1893.

The 40 × 120-ft. steel stand-pipe at East Providence, R. I., collapsed in the upper 35 ft. of its

* Copyright 1894, Engineering News Publishing Co.

height during a severe gale about 7:00 p. m., Sept, 7, 1893, bending as shown by Fig. 13. As planned its height was to be 125 ft., but at the time of the accident the topmost course of plates with its stiffening angle was lacking. On Aug. 29, about a week preceding the accident, a severe wind storm struck the stand-pipe before the 24th course of plates was entirely completed, during which the top of the structure swayed violently in and out, and the empty stand-pipe was lifted ¾ in. or more from the foundation on the windward side. However, upon pumping it full of water no damage was observed and it was again emptied, in which condition the collapse took place as above mentioned during the most severe portion of the later storm, which resembled a cyclone. The excellent quality of the material and workmanship was strikingly displayed when, upon the day following the accident, the stand-pipe was again pumped full and the indented portion was sprung into shape. A single leak was found at the lower extremity of the bent plates, being due to a few strained rivets which were replaced, leaving the structure apparently "as good as new."

The unusually large diameter of this stand-pipe,

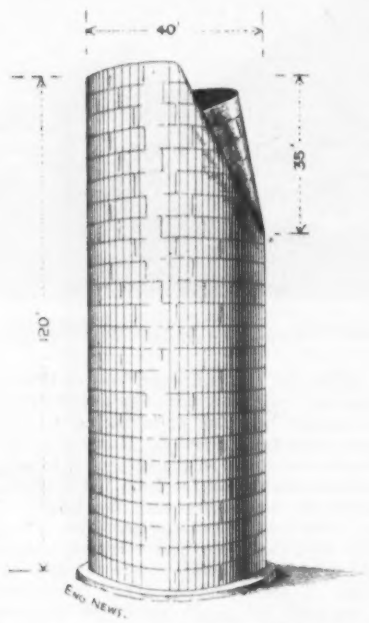

Fig. 13. View of Indented Stand-Pipe, East Providence, R. I., Sept. 7, 1393.

considering its height, makes its general construction, as shown by the specifications, particularly interesting.

The finished stand-pipe was to have 25 courses of plates, each 5 ft. in height. The thicknesses were to be as follows:

Course.	Thickness, inches.	Course.	Thickness, inches.
1	1 9-32	9	¾
2	1 3-16	10	11-16
3	1 5-32	11	⅝
4	1 1-16	12	9-16
5	1	13 and 14	½
6	15-16	15 and 16	7-16
7	¾	17 to 20 inclusive	⅜
8	13-16	21 to 25 inclusive	5-16

The bed-plate was ¾ in. thick and 41¼ ft. in diameter, formed of radial strips. The 1 9-32-in. bottom course was secured to the bed-plate by a 6×6-in. angle, double riveted with 1 in. rivets spaced 2¾ ins. between rivets and 2¼ ins. between rows. Triple riveting with 1⅛-in. rivets and 8-in. laps was used in the first five horizontal and vertical seams; double riveting was used in the next ten horizontal and in the remaining vertical seams; and the last five horizontal seams were single riveted. The stand-pipe was erected by using inside staging.

The record from the self registering anemometer at Providence, about the time of the accident, indicates a maximum velocity of close to 38 miles per hour, and the extreme velocity recorded elsewhere during the same storm was somewhat above 40 miles per hour; but it is probable that the actual ultimate velocity during the most violent portion of the storm reached a considerably higher figure than indicated by the records above quoted. During the severe wind storm several days preceding the collapse, the estimated velocity of the wind when the stand-pipe was slightly lifted on the windward side was 60 miles per hour, which may with reason be assumed as the probable extreme velocity during the later storm. It is, however, important to observe that the collapse was perhaps directly due less to the actual maximum force of the storm than to the coincidence of successive gusts of wind with the vibrations of the sides of the empty tank.

References.—Engineering News, Vol. XXX., pp. 205, 237 (Sept. 14, 21, 1893). Engineering Record, Vol. XXVIII., p. 298 (Oct. 7, 1893). Correspondence with the city engineer, Providence, R. I., and with the chief of the Weather Bureau (1893). Engineering News, Vol. XXXI., p. 76 (Jan. 25, 1894). Engineering Record, Vol. XXIX., p. 135 (Jan. 27, 1894).

East Providence, R. I., Jan. 19, 1894.*

The 40×125-ft. steel stand-pipe at East Providence, whose collapse during a severe wind storm on Sept. 7, 1893, was described just above, burst at 7:50 p. m. on Jan. 19, 1894, at which time it is said to have contained less than 100 ft. of water.

As stated in the foregoing description of the first accident, the damage resulting from the collapse was supposed to have been slight, being confined apparently to the wrinkles in the plates at the lower limit of the collapsed portion. After considerable effort by the contractor, the wrinkles were so much reduced as to be scarcely perceptible when the water level was above them; but upon lowering the water to the 85-ft. level the dent in the plates became so distinct that the local authorities would not accept the structure from the contractor, and finally it became necessary to suspend operations on account of the cold weather. Previous to the latter, however, the sub-contractor for the roof and balcony had proceeded with and completed his work, although the floating staging, consisting of timber and barrels, which had been used by him in erecting the roof, had not been removed from the stand-pipe at the time of its final failure. For some time prior to Jan. 14, about one week previous to the failure, there had been no communication with the mains, but on that date the valve was opened by the contractor after cutting the ice on the surface of the water loose from the walls of the stand-pipe. This communication with the mains was not disturbed up to the time of the failure, when, as already stated, the water level is said to have been less than 100 ft. above the base.

The ruins of the wrecked stand-pipe are thus described by Mr. G. H. Leland, Assistant to the Designing and Consulting Engineer:

From general appearances it seems the pipe first burst at a point 55 ft. above the bottom on the southwest side. The first ten bottom courses on the same side were rent asunder and were unrolled and carried a distance of 150 ft. to the northeast with the lowest course farthest away from the foundation and outside uppermost. One large section of the bottom course was hurled over a pile of earth, some 10 or 12 ft. high, without even scratching the earth.

The upper 75 ft. appear to have dropped perpendicularly just south of the foundation and then toppled over to the south. The roof lies all within the pipe, with the peak lying diagonally down, excepting one dormer window, which was hurled to one side. * * * The foundation of the pipe, which was laid up in Portland cement, remains intact. The bottom of the stand-pipe remains on the foundation, but with the edges torn and twisted. * * * The heavy steel plates that composed the lower courses are bent, twisted and torn into innumerable shapes and sizes, but the triple-riveted joints remain firm and solid; in one or two cases, however, the double-riveted joints pulled apart instead of tearing the plates. * * * The fractures and flexures of the steel plates show an excellent quality of material.

In addition to the above, the following statement from the same authority is of much interest, in that it suggests the most plausible theory for the failure of the stand-pipe:

Large blocks of ice lie strewn around in various directions, varying in thickness from 3 to 18 ins. Several large rectangular blocks of ice 2 to 3 ft. square and 3 ins. in thickness were found with the imprint of the river heads, showing that the ice was formed more or less to the inside of the pipe, to just what extent it is impossible to state.

From information obtained through another source, it seems that rattling sounds were heard within the stand-pipe upon the day preceding the accident, but no opinions as to the probable cause, either of the sounds or the failure itself, have been advanced. It therefore becomes necessary to carefully consider all facts bearing upon that point; and inasmuch as the quality of plate-metal as indicated by the results of both accidents, seems to have been of unusual excellence, any reasonable theory must account for the existence of extraordinarily severe conditions.

At first thought it would appear that the failure was in some manner the result of the earlier accident, but it is observed that the 35-ft. portion at the top, which had previously collapsed, was entirely included within the 75-ft. section which toppled to the southward after the lower ten courses had burst. It is, nevertheless, not impossible that the plate-metal, even though exceptionally superior in quality, might have been damaged or overstrained at some point below the collapsed portion during the period of excessive vibration which accompanied and preceded the first accident. However, admitting the existence of such defects, it is difficult, if indeed possible, to explain how such a cause, acting singly, could have produced the disastrous results; although there is reason to conclude that such defects, if any existed, may have had an important auxiliary influence when acting in connection with other elements.

The wide variation in the thickness of the ice found in the ruins, indicates that the ice tube which formed, during the period of cold weather while communication with the mains was cut off, was eccentric in shape, having a thickness of 18 ins. on the northern side and of only 3 ins. on the southern or southwestern side, where the action of the sun was greatest. (In proof of the latter idea, reference is made to Eng. News, Vol. XXVII., p. 347 (April 9, 1892), which describes the construction of a 30×100-ft. stand-pipe by the floating derrick system in a western city. The stand-pipe proper had been completed and it was intended to rivet on the stairway brackets by gradually lowering the float, "but it was found that a ring of ice had formed inside the stand-pipe, 18 ins. thick on the north side, but only 2 ins. thick on the south side where it was exposed to the sun.") The tube of ice in the East Providence stand-pipe doubtless formed against the interior cylindrical surface up to the stationary level of the water and it would seem that the connection of the ice with the bed-plate was watertight. Assuming such to have been the case and that the action of the sun upon the south or southwest side of the stand-pipe had formed a film or pocket of water between the metal and ice shells upon that side, it is only necessary to have had a freezing temperature in order to subject the stand-pipe to strains probably more severe than may be otherwise possible, unless, perhaps, it be those which are produced by the fall of a large body of ice through a considerable distance. Inasmuch as the latter was impossible under the existing circumstances the former is here advanced as the most probable explanation of the failure. It may properly be added that according to this theory the pocket, and consequently the initial rupture, would naturally occur on the south or southwest side of the stand-pipe, and that rupture might take place at almost any point in the lower nine-tenths of the height of the ice tube, the strain required to produce rupture growing less, of course, with the decrease in the thickness of the plates. Thus, it will be seen that if the initial rupture took place at a point 55 ft. above the base as above suggested, the pocket of confined but unfrozen water probably existed there, and the failure originated in a plate having a thickness of ⅝ in. It is, furthermore, of importance to observe that the formation of such pockets is probable only when the ice tube extends to a tight connection with the bed-plate, which latter condition may rarely if ever be found to exist except when the stage of the water remains constant for some time during freezing weather, such for instance as was the case of the Asheville stand-pipe. In proof of the fact that the force generated in the manner above indicated would be sufficient to cause plate fracture, reference may be made to the well-known "bomb-shell" experiments or to the various evidences in nature of the powerful action of frost.

References.—Engineering News, Vol. XXXI., pp. 76, 112, 160, 180, 202 (Jan. 25, Feb. 8 and 22, March 1 and 8, 1894). Engineering Record, Vol. XXIX., p. 135 (Jan. 27, 1894).

* Illustrations of this failure were given in Engineering News of Feb. 8 and 22, 1894 and will be included with the text when republished in book form. —Ed.

Peoria, Ill., March 30, 1894.

In view of the extended space which has already been given to the Peoria stand-pipe failure in these columns, it is deemed unnecessary to here present a description of the structure itself or of its ruins.

It is sufficient to state that the cause of the failure has been fixed primarily upon the defective quality of the plate metal, due, mainly to an excess of phosphorus. It is not stated that the specified tests of quality were made during construction of the stand-pipe. However, the requirement for ductility was so strikingly lax that its enforcement was of little importance, for it is quite probable that a strip from even the thickest of the Peoria plates might have bent cold about a diameter of 40 ins., as specified, notwithstanding the distinctly brittle character of the metal. The almost certain damage to plates of this quality in the process of punching suggests that partial fractures, originating in this manner, may have been extended during the sudden and excessive fall of temperature within a week preceding the failure, by the enormous expansive force caused by the freezing of water which had leaked into imperfectly filled rivet holes.

Whether a local weakness was produced in the manner suggested or by other means it is true that the initial rupture took place at or near the point on the north side of the stand-pipe where calking was in progress; and it is generally believed that the failure was precipitated by the sharp vibrations produced in the metal shell by the calker's blows. Although the strong wind which was blowing at the time probably had a relatively slight influence upon the full tank, its effect in causing the fall of the unruptured top portion to the leeward is quite evident.

It should be stated that the details of the stand-pipe were uniformly excellent and that with proper quality of metal in the plates the structure would have been entirely safe.

THE COST OF A CANADIAN DIRT ROAD.

In a paper upon "Common Roads," read by Mr. C. R. F. Coutlee, before the Canadian Society of Civil Engineers, the following notes occur upon the cost of earth roads in Canada:

The road taken as an example has a width of 16 ft. with a crown of 1 ft.; with side ditches 8 ft. wide and 3 ft. deep below crown; the outside slope of the ditch being about 1 to 1. Assuming 5,000 cu. yds. of material, say clay, per mile, the cost of the earth road is approximated as follows: With round haul from ditch to road about 40 ft.; vertical lift 2 ft., drag scrapers should average 2.0 cu. yds. per day. This would amount to 25 days' work for a team, or 2½ days' work for 10 teams.

10 teams scrapers at....	$3.00 for 2½ days	$75.00
2 teams plowing and harrowing at.....	3.00 for 2½ days	15.00
2 men filling and harrowing at.....	1.25 for 2½ days	6.25
2 dumpmen filling and harrowing at.....	1.25 for 2½ days	6.25
Grading, total per mile.....		$102.50

A man taking a contract for road work on highways within 2½ miles either side of his own place could use his horse in spare time and feed in his own stables. So $3 per day would be full wages.

To compact 18 ft. wide by rolling with a 5-ft. roller would necessitate passing on each side with the outside edge of the roller following a line 9 ft. from center line. The next passage would be 2½ ft. nearer center on each side; then along the center. Over the three central widths of 5 ft. the roller would be passed five times; thus making 20 trips, or 20 miles of rolling for one mile of road, consuming with delays one day's work of a team. In addition, five men would be required to trim behind the roller. The expenses for rolling one mile would thus be:

1 team at.....	$3.00 for 1 day	$3.00
5 men trimming at.....	1.25 for 1 day	6.25
Rolling one mile.....		$9 25

The grading, spreading and rolling would thus amount to $111.75 per mile; or, with 12% added for contingencies, say $125 per mile, or 2.4 cts. per lin. ft. Superintendence, fencing and structures are not considered in this cost.

Mr. Coutlee, in discussing road maintenance, assumes that after each snow or rainstorm some work must be done, and he then takes the following bill of repairs for ten miles of road in Canada:

Dec. (1891), Feb. and March—Snow giving work for 15 days:		
1 team (plow and roller) at	$3.00 for 15 dys.	$45.00
5 men at.....	1.25 " "	93.75
April—Breaking up necessitates 15 days' work:		
1 team (harrow, roller, etc.) at	$3.00 for 15 dys.	45.00
5 men at.....	1.25 " "	93.75
May and June—Rains and traffic, 25 days' work:		
1 team (roller, etc.) at.....	$3.00 for 25 days	75.00
2 men at.....	1.25 " "	62.50
July, Aug. and Sept.—Rains and traffic, 15 days' work:		
1 team (roller, etc.) at.....	$3.00 for 15 days	45.00
2 men at.....	1.25 " "	37.50
Oct. and Nov.—Rains, etc., until frost, 20 days' work:		
2 teams (rollers, etc.) at...	$3.00 for 20 days	120.00
5 men at.....	1.25 " "	125.00
Total for 10 miles.....		$727.50
Average for 1 mile, say.....		$75.00

This means the expenditure per mile per year for maintenance alone of one day's labor by about 11 teams and 33 men.

AN UNDERGROUND ELECTRIC RAILWAY IN LONDON.

Another underground railway is to be built in London and will be operated by electricity on practically the same system as the City & South London Ry., which has now been in operation for about three years. The new line is the Waterloo & City Ry., which will be 1½ miles long and will run from the Waterloo terminal station of the London & Southwestern Ry., on the south side of the Thames, to a point near the Mansion House, one of the busiest centers of the city. The capital has been raised and the shares have the guarantee of 3% by the London & Southwestern Ry. Co., which agrees to work the line at 55% of the gross receipts, and divide surplus over the guarantee in the proportion of ⅔ to the Waterloo & City Ry., and ⅓ to the London & Southwestern Ry. The contract has been let to John Mowlem & Co., at $1,145,320, the work to be completed in 30 months. Of seven bids five were very close and the highest bid was $2,229,145.

There will be no intermediate stations, the principal purpose of the railway being to give the London & Southwestern Ry. passengers direct connection with the city. The Waterloo station will be 50 ft. below the main station, and connection between the two will be by inclined way and stairways instead of by elevators. From this station two circular tunnels 12 ft. diameter will stand on a grade of 1.66% to get below the bed of the Thames, leaving 20 ft. of cover between the river bed and the top of the tunnels. On the north side the line will rise by a grade of 1.15% to the terminus, which will be 63 ft. below the street level, so that it is naturally considered that the company's plan of using inclines and stairways will have to give place to one involving the use of hydraulic elevators.

As far as it has been ascertained the whole of the passage under the Thames will be through the London clay, so that no difficulty is apprehended in this part of the work. If there is any trouble in boring the tunnels it is to be looked for in the shingly, watery soil likely to be encountered before dipping down to the clay beneath the river. On the south approach the tunnels will not have gone low enough to reach this clay, and it is probable that the excavations, which will be carried on by the Greathead shield method, will have to be effected under considerable atmospheric pressure. The work will be done under the direction of Mr. J. H. Greathead and the engineers of the London & Southwestern Ry., Messrs. J. Galbraith and C. Church.

In regard to the rolling stock of the new line, experience on the City & South London Ry. has suggested some modifications, as it has been found that the existing electric railway would have done much better but for the limited dimensions of its cars. The tunnels are only 10 ft., or 10 ft. 6 ins. in diameter, and the cars cannot be made larger. They are capacious enough for the quieter hours of the day, but morning and evening, when they might be earning good dividends, they cannot cope with the traffic, more especially as the city end of the line is badly cramped for room. The Waterloo & City Ry. will have its straight tunnels 12 ft. in diameter and somewhat larger at the curves so as to allow for the turning of their cars. The cars will be 9 ft. wide and will each seat 50 passengers. Trains will be composed of seven cars, so that a full train-load will be 350. On the existing line a full load is said to be about 100. Whether the new line will adopt two classes of passengers or only one, as on the existing electric railway, is not yet decided.

STOPPING LEAKS IN A LOCK FOUNDATION BY MEANS OF COMPRESSED AIR.

The ship canal connecting Amsterdam with the North Sea ends at the little fishing village of Ymaiden. At this latter point it was determined to replace the old locks of 1874 by larger locks. After due examination and study it was determined to make the necessary excavation for the new locks by excavators, working in the dry down to about 36 ft. below datum, the soil to that point being practically impervious. Beton was put over this excavated area of 40,000 sq. m. to a depth of 8.2 ft. and two centrifugal pumps were sufficient to carry away the water coming through; though this floor was about 33 ft. below the level of the canal and only 656 ft. from the sea.

After the masonry was built it became necessary to stop these springs, which in several places had washed the cement out of the beton. To do this a novel method was resorted to, says "Le Genie Civil." The parts affected were in one case 29½ ft. in diameter and in another about 29×18 ft. These areas were covered by beton domes made on wooden centers with a rise of 5.4 ft. The beton used was made of one part Portland cement, one part sand and two parts of broken brick, and the domes themselves were about 4.6 ft. thick. A coating of pure cement made the domes airtight and in an opening left in the crown of the dome was placed an iron tube, held in place by an angle iron collar and surmounted by an air lock.

The working chamber thus provided was supplied with compressed air from a compressor near by, and a 2½-in. iron pipe built into the side carried away the water forced out under the air pressure. The maximum air pressure required did not exceed 8.4 lbs. to the sq. in. When the water had been expelled the defective beton was replaced by new beton, which was allowed to set for at least 48 hours before the air pressure was taken off and the domes demolished. The water was effectually stopped.

Some of the nitrate fields in the province of Tarapaca, Chile, are to be sold at Santiago on June 15. Plans, conditions of sale and other particulars may be obtained at the offices of the Chilean consuls at New York, Boston and Philadelphia.

Gold deposits have been found in the Rainy Lake district on both sides of the border between Minnesota and Ontario, and several mining camps have already been established. The gold is said to exist in well-defined veins and the assays to run sufficiently high to show that mining will be profitable.

Experiments on electric communication between lightships and shore stations have been made by Prof. Blake, of the University of Kansas, under the supervision of the Lighthouse Board. The mushroom anchor securing the lightship has a cable running to the shore, and the electric current is carried up the anchor chain. At each end of the line is a 20-cell battery furnishing a 20-ampere circuit. Two or three lightships will probably be equipped with the apparatus this summer.

Whitewashing by machinery is being tried by Mr. F. B. Griffith, Division Master Mechanic of the Delaware, Lackawanna & Western R. R., on somewhat the same plan as used for kalsomining the buildings of the Columbian Exposition (Eng. News, Feb. 23, 1893). An old freight car has been fitted with three air-brake pumps and two reservoirs, the pumps being driven by steam from an engine and a pressure of 40 lbs. being maintained in the reservoirs. The car and engine are run upon the track alongside the building to be whitewashed. By a system of piping the air is carried into the building, and to the long iron nozzles used by the men in applying the fluid. Each man has an iron tube with a funnel-shaped end, from which the whitewash is sprayed upon the woodwork. To each nozzle are attached two lines of hose, one supplying the air and the other the whitewash. The flow of both is controlled by a valve manipulated by the operator. When opened, the air rushes into the cylinder of the nozzle and its pressure causes a suction that brings up a stream of whitewash and at the same time expels it in the form of spray.

CONSTRUCTION NEWS.

(Readers are invited to contribute items concerning new construction of interest to engineers or contractors for insertion in these columns. Those using these pages for information are informed that announcements of calls for proposals are inserted but once, and are not repeated from week to week.)

RAILWAYS.

East of Chicago—Existing Roads.

ATTICA & FREEDOM.—It is stated that F. H. Goodyear, Buffalo, N. Y., First Vice-Pres. Buffalo & Susquehanna, has made a proposition to rebuild and operate 30 miles of this railway from Attica, N. Y., if the towns along the road will subscribe for $75,000 of the bonds to be issued to make these improvements.

LONG ISLAND.—Austin Corbin, Pres., is reported as stating that if the bill introduced in the senate for the establishment of a free port at Fort Pond bay, on the extreme easterly end of Long Island, becomes a law, this road will be at once extended to that place, which is 30 miles from its present eastern terminus.

OSCAWANA & CORNELL.—Jas. S. Haring, Ch. Engr., Box 54, McKeesport, Pa., writes us that the contract for constructing this road, from Oscawana, N. Y., to Cornell Dam, about 5 miles, was awarded to A. D. Marshall and Herman Force and ¾ mile of road partly constructed, but no money was ever paid the contractors and the work was abandoned. Efforts are now being made to reorganize the company. Wm. H. Glade, Pres., died Nov. 7, 1893. The work consists of 60% rock excavation; maximum grade, 2.2%; maximum curvature, 10°.

Projects and Surveys.

BLOOMVILLE & DELHI.—It is stated that preparations are being made to construct this railway from Bloomville to Delhi, N. Y.

PENNSYLVANIA & NEW JERSEY.—Incorporated in Pennsylvania May 5 to do a general connecting railway business, operating between Frankford Ave., and foot of Roxboro St., Philadelphia; capital stock, $300,000; Pres., Henry D. Welsh, Philadelphia; directors, John P. Greene, Wm. A. Patton.——A company of the same name was incorporated in New Jersey May 8 to construct a railway in Camden county; capital stock, $100,000; : W. J. Sewell, A. O. Dayton and Wilson Brown, Camden; H. D. Welsh, Philadelphia, and others.

RONDOUT VALLEY.—Organized at Kingston, N. Y., to build a railway from Rondout through Kingston, Stone Ridge, Marbletown, High Falls and Rochester to Ellenville. Wm. Lounsbery, Kingston, is interested.

WISCASSET & QUEBEC.—The construction of this railway in Maine will be commenced this month, according to reports. Jas. McGregor, Rumford Falls, Me., and Alex. McGregor, New Brunswick, have a contract for grading 15 miles of the line. Ch. Engr., N. Nickerson, Wiscasset, Me.

Southern—Existing Roads.

MONTGOMERY, HAYNEVILLE & CAMDEN.—S. D. Block, Pres., Camden, Ala., writes us that contracts will probably be awarded in June for resuming work on this road. It is hoped to complete the road this year. The line extends from Camden through Furman, Farmersville, Gardensville and Hayneville to Montgomery, Ala., 75 miles, of which 11 miles have been entirely graded. The work will include 4 large bridges and 1½ miles of swamp to be crossed.

OXFORD & COAST LINE.—A. A. Chapman, Ch. Engr., Oxford, N. C., writes us that it is hoped to resume work on this road in a few weeks. The road when completed will be operated by the Seaboard Air Line.

SAVANNAH, AMERICUS & MONTGOMERY.—Press reports state that arrangements are being completed for taking this road out of the receivers' hands and raising $1,000,000 to extend the line to Savannah, Ga., 75 miles.

SUMTER, LAKE CITY & CONWAY.—H. W. Mackey, Pres., Sumter, S. C., writes us that about $75,000 of local aid has been secured for the construction of this railway in South Carolina and that the line is now being graded. The road is backed by the Atlantic Coast Line and the Northeastern.

WEST VIRGINIA.—It is stated that H. Calbach & Sons, Lebanon, Pa., have commenced the construction of a narrow gage railway 12 miles long between Pickens and Mayton to open up a tract of timber land.

Projects and Surveys.

KENTUCKY.—Press reports state that John R. Deer, Duluth, Minn., has been awarded a contract for the building of 60 miles of railway in this state, from the terminus of the Ohio and Big Sandy, at Richardson, to the coalfields of Pike county.

PARSONS BOOM & LUMBER CO.—This company of Parsons, W. Va., is reported as about to construct a standard gage railway from Parsons up Shaver's Fork of Cheat River, 5 miles.

Northwest.—Existing Roads.

BURLINGTON & MISSOURI RIVER.—I. S. P. Weeks, Ch. Engr., Lincoln, Neb., wrote us last month that no work had been done on this road this year; since then however grading has been resumed by about 500 men, near Sheridan, Wyo., on the extension to connect with the Northern Pacific about 12 miles east of Billings, Mont. This extension will be about 125 miles long and is to be completed by Oct. 15. Kilpatrick Bros. & Collins, Lincoln, Neb., who have built the road from Grand Island, Neb., west, are the general contractors and subcontracts have already been let to W. S. Heckert, John Doolittle and Walsh & Reese. Owing to the financial depression the construction of this extension is said to be undertaken at a less expense than has heretofore been paid, $1.25 and upward per day being paid for labor. Probably 2,000 to 3,000 men will soon be employed on this line. After this Montana branch is completed it is expected that the main line will be extended from Sheridan, Wyo., which is 750 miles northwest of Omaha, west to the Yellowstone Park, through it or south of it to Boise City, and thence to San Francisco.——Plans and specifications have been prepared by this company for improvements to cost $400,000 to $500,000 to be made at Kansas City, this year. The yards of the company will be greatly enlarged and the terminal facilities more than doubled.

CHICAGO, ROCK ISLAND & PACIFIC.—Press reports state that this company has its surveyors out on the line of the short cut between Beatrice, Neb., and Herrington, Kan., clearing the way for the new road. This road will shorten the distance between Omaha and Texas by about 100 miles.

GREEN BAY, WINONA & ST. PAUL.—It is reported that arrangements have been completed for building an extension from Scandinavia to Waupaca, Wis. About 4½ miles of the line were built last year from Scandinavia north under the name of the Iola & Northern.

ILLINOIS CENTRAL.—This company is reported as about to build an extension from Onawa, Ia., to Omaha, Neb. The work has been in contemplation for several years, and it is stated that the surveys made last year by the Nebraska Central have been accepted for the line. The distance is about 50 miles.

YANKTON, NORFOLK & SOUTHWESTERN.—Wm P. Dewey, Jr., Yankton, S. Dak., writes us that it is hoped to commence tracklaying on this road the latter part of next month. About 65 miles, or 70 with sidetracks, of the line have been graded, as follows: Yankton to Missouri River, 4 miles; Missouri River to Osmond, Neb., 36 miles; Osmond to Pierce, Neb., 12 miles; and from Pierce to Norfolk, Neb., 14 miles, the contracts have been let. Owens Bros. are the chief contractors for the grading, and W. W. Graham for the bridging, under the Traffic Construction Co., Yankton, the general contractors for the entire work. The line from Norfolk to Superior, Neb., 140 miles, has not yet been surveyed. The road is being built across a rolling prairie country, well settled and very productive; grade of 3-10% and very light curvature. It is an independent line and has been granted local aid of about $15,000 per mile. The work includes a 1,000-ft. bridge at Yankton, for which soundings have been taken. The bridge will have 5 spans and the depth to bed rock is 52 ft. Address all communications to the secretary of the Traffic Construction Co.

Projects and Surveys.

SHEBOYGAN & ST. PAUL.—Incorporated in Wisconsin to built a railway from Sheboygan to a connection with the Chicago, Milwaukee & St. Paul, at Waldo; capital stock, $250,000; Pres., Jerry Donohue; Vice-Pres., Frank Roenitz; Secy., Jas. Mailman; Treas., Theo. Dieckman, all of Sheboygan, Wis. The city council of Sheboygan has been asked to grant $50,000 in 4½% 20-year bonds as a bonus to the road.

SHEBOYGAN, ST. PAUL & CENTRAL.—Incorporated in Wisconsin to build a railway from Sheboygan to Schleisingerville, Wis., 44 miles; capital stock, $250,000; directors, Wm. Z. Wilson, Milwaukee; J. F. Huntoon, Chas. W. Johnson, John D. Cameron and J. R. Briggs, Chicago. The company has asked the city of Sheboygan to issue $50,000 in 4% bonds for the same amount of stock.

WYOMING.—A press report from Casper, Wyo., states as follows: J. H. Negus, the promoter of the scheme to build a railway to connect the Northwestern at Casper and the Union Pacific at Rawlins is still hopeful of carrying his project through, although he has been unable as yet to interest Eastern capitalists in the enterprise. He is now working on a scheme to build a tramway between these points. Mr. Negus is interested in the Johnstown soda lakes in the southwestern part of Natrona county, and he believes that if an outlet can be secured to market, capital can be obtained to develop the great mineral resources of that section.

Southwest—Existing Roads.

ATCHISON, TOPEKA & SANTA FE.—This company is reported as about to construct an extension from Albuquerque, N. Mex., to the new Cochiti gold camp.

CALCASIEU, VERNON & SHREVEPORT.—Press reports from Lake Charles, La., state as follows: Engineers began May 2 locating the track for this railway, which is already graded and has about 15 miles of track laid west from Houston River. Work will be at once commenced on the east end, opposite this city, at West Lake. The road is to be completed to Shreveport later in the year. The stock is principally owned by the lumber firm of Lock, Moore & Co., of this city. It is narrow gage and intended mostly for transporting lumber.

CHOCTAW COAL & RY.—J. D. Bradford, Manager, S. McAlester, Ind. T., writes us that plans are being made for reorganizing this company, now in the hands of a receiver. Press reports state that the company has completed arrangements with G. W. Kirkbride, Philadelphia, for the construction of the gap on its road between South McAlester and Oklahoma City, 121 miles, and the building of a road from Wister Junction, its eastern terminus, to Little Rock or Memphis, and that it is expected that within 30 days active work will be begun and pushed to completion. Mr. Bradford states that 15 miles of the extension to Oklahoma City have been graded and that the entire right of way has been obtained. About 100 miles of the line will be over a rolling prairie and the remaining 21 miles will be heavy work; maximum grade of 1% and curvature of 3°. There will be one 800-ft. bridge.

GREENFIELD & NORTHERN.—Surveys are being made for a line from Greenfield to Clinton, Mo., according to press reports.

LOUISIANA NICKEL PLATE.—W. G. Wadley, Manager, Allentown, La., writes us that this is a private road upon which 3 or 4 miles of extensions are built at a time as needed. An extension of 2 miles is now being made. The work is not done by contract. The line has been in operation for three years and its projected length is 40 miles, when it will meet the road of the Bodcaw Lumber Co. and the two will make a line 60 miles in length from the V. S. & P. to the main line of the St. L. & S. W. The principal source of traffic is lumber and cotton.

MISSOURI SOUTHEASTERN.—Geo. H. Crumb, Pres., Bloomfield, Mo., writes us that this road was built from Zeta, 19 miles south of Delta, on the St. Louis Southwestern (Cotton Belt), to Bloomfield, 6.8 miles, in 1893, but the work was discontinued on account of the financial stringency. The work was resumed in January and the road is being put in order, terminals completed, etc., and will be opened for regular traffic this month. Extensions will be made this year, but it is not desired to make a statement concerning them at this time.

MISSOURI, KANSAS & TEXAS.—Cary A. Wilson, Ch. Engr., Parsons, Kan., writes us that surveys have been completed for an extension from Green Ridge, Mo., to Holden, Mo., 33 miles, and press reports state that the contract for the construction has been awarded, the work to be commenced May 15 and be completed within six months. Green Ridge is 12 miles south of Sedalia, on the main line, and at Holden a connection will be made with the Parsons & Pacific, thus furnishing a through line to Kansas City by way of the Missouri, Kansas & Eastern.——Mr. Wilson states that surveys have also been made for an extension from San Marcos or Lockhart, Tex., to San Antonio, 60 miles.

NEW ORLEANS & NORTHWESTERN.—C. H. Shatman, Ch. Engr., Natchez, Miss., writes us that the extension from Rayville to Kellers, La., on the Missouri Pacific system, 17½ miles, is about completed and will be opened for traffic this month. Bagwell & Johnson, St. Louis, are the principal contractors, and J. Campbell, J. Harding & Co. and M. S. Carter & Co., St. Louis, the subcontractors. Ch. Asst. Engr., W. T. Gould, Rayville, La.

STUTTGART & ARKANSAS RIVER.—A correspondent writes us that this road will be extended at once to Gillett, Ark. The road is projected from Stuttgart, Ark., to Pendleton, 45 miles, and is completed to Greenwald, 34 miles. A. V. Stafford, Gen. Man., Stuttgart, Ark.

TEXAS MIDLAND.—Bids are asked until May 19 for extending this railway, 20 miles, from Roberts, Tex., north. Pres., E. H. R. Green, Terrell, Tex.

Projects and Surveys.

BRAZOS & BURLESON.—Incorporated in Texas to build a railway from Moseley's Ferry, on the Brazos River, the terminus of the Hearne & Brazos River road, through Brazos and Burleson counties to the line of the Gulf, Colorado & Santa Fe at or near Clay Station in Burleson county, about 22 miles; capital stock, $100,000; incorporators, H. K. White, Milton Parker, Wm. Koppe, John P. Chance, Jas. S. Chance, J. W. Johnson, M. W. Sims, W. G. Tallaferro, T. R. Batte, N. B. Cole and J. W. Carleton, of Brazos county, and W. J. Moore, Robert S. Newsome, of Burleson county.

DALLAS BELT.—It is reported probable that bids will be asked in a few days for constructing this railway, about nine miles in length. Gen. Man., F. M. Cockrell, Dallas, Tex.

GALVESTON & GREAT NORTHERN.—This company was recently incorporated with a capital stock of $18,000,000 to build a railway from Niobrara, Neb., south through the grain fields of Nebraska and Kansas; through Oklahoma and the coal fields of Indian Territory to Denison, Tex., and thence south to Galveston. Edward Roemer, Pres. and Ch. Engr., has been conferring with the citizens of Denison, Tex., in regard to locating the line through that city and he is reported as stating that 100 miles of the road will be built as soon as the necessary arrangements can be completed, the money being in hand. P. J. Dougherty, New York; D. F. O'Rourke, Altoona, Pa., and Judge Clark, Sterling, Kan., are also interested in this company.

LOUISIANA.—Efforts are being made at Thibodaux, La., to secure the construction of a railway from Rousseau Station, on the Southern Pacific, about six miles below that city, to a point opposite the town of Labadieville, nine miles above the city. Thos. H. Rogers and E. G. Robichaux are interested.

MEMPHIS, HEBER SPRINGS & NORTHWEST ARKANSAS.—Organized to build a railway from Bald Knob, on the Iron Mountain, north to Heber, Cleburn county, Ark., a distance of 72 miles; Pres., J. R. B. Moore, Heber, Ark.; Vice-Pres., R.P. Hitchcock, Batesville, Ark.; Secy., B. C. Myers, Little Rock; Treas. W. H. Ragland, Little Rock.

ROCKPORT, TARKIO & EASTERN.—D. A. Quick, Ch. Engr., Rockport, Mo., writes us that this projected railway will be eight miles in length and that over half of the right of way has been obtained. Pres., Dr. G. Chamberlain, Rockport, Mo.

ST. LOUIS, AVOYELLES & SOUTHWESTERN.—Ira W. Sylvester, Ch. Engr., Alexandria, La., writes us that preliminary surveys have been made for this railway and that contracts will probably be awarded next month for the construction,, tracklaying to be commenced July 1 and the line open for traffic by Oct. 30. The route is from Bunkie through Evergreen, Cottonport, Long Bridge, Mansura, Macksville, Moreauville, Hamburg and Simmesport, 34 miles. The grades and curves will be very easy.

Rocky Mt. and Pacific—Existing Roads.

COOS BAY, ROSEBURG & EASTERN.—Press reports state that preparations are being made to resume work on the extension of this road to Roseburg, Ore.

FLORENCE & CRIPPLE CREEK.—This company had completed 24 miles of its line to Cripple Creek, Colo., on April 28.

GILA VALLEY, GLOBE & NORTHERN.—A. C. Laird, Secy., Bowie, Ariz., writes us that 12 miles of this road had been graded April 24 and that tracklaying would be commenced May 15. About 60 men and teams are at work on the line. The line extends from Bowie through Solomonsville, Safford, Thatcher, Pima, Thomas and San Carlos to Globe, about 125 miles, all in Arizona. About 60 miles have been surveyed and the right of way secured. The work is light; maximum grade of 1% and maximum curvature from Bowie to Thomas 6°. The Midland Construction Co. are the contractors.

MONTANA SOUTHERN.—S. M. Kielland, Ch. Engr., Box 533, Helena, Mont., writes us that surveys have been in progress all winter on the proposed extensions of this road, but that nothing had been decided upon as

to the construction. The road has been graded from Whitehall south to Twin Bridges, 25½ miles, and surveys made to Laurin, 16½ miles from Twin Bridges. In all about 100 miles have been surveyed.

SAN DIEGO & PHOENIX.—Wm. H. Carlson, Pres., San Diego, Cal., writes us that bids are asked for the sale of $7,500,000 of 20-year 6% first mortgage gold bonds ($20,000 per mile built) for the construction of this railway, which is projected from San Diego, Cal., to Phoenix, Ariz., 335 miles. The company has already secured valuable franchises and right of way, has over 1,000 stockholders and is building the road as fast as the necessary money is secured.

SOUTHERN PACIFIC.—Wm. Hood, Ch. Engr., San Francisco, Cal., writes us that since Jan. 1, 1894, track has been laid from Santa Margarita, Cal., to Steinner Creek, 13 miles, where an iron viaduct 930 ft. long, with 23 spans, is being constructed; from Santa Margarita to San Luis Obispo, 16.7 miles, partially graded; San Luis Obispo to Guadaloupe, 25 miles, surveyed; Guadaloupe to Elwood, 95 miles, not yet surveyed. The 7 tunnels through the Santa Lucia range of mountains, on the extension to San Luis Obispo, aggregate 7,885 ft. in length, and have been completed. Concerning the extension of the line from San Luis Obispo to Elwood, Mr. Hood states that the work will be moderate both in grades and curvature. The right of way has been obtained by a committee of citizens and no additional local aid is asked. The route south of Guadaloupe has not been decided upon.

VANCOUVER, KLICKITAT & YAKIMA.—It is stated that this railway in Washington has been sold to New York capitalists for $110,000, and that it will be extended to connect with the Northern Pacific. The name will be changed to the Portland, Vancouver & Northern.

Projects and Surveys.

BLAINE & EASTERN.—Press reports state that the contract for building 22 miles of this road from Blaine to Lynden, Wash., has been awarded to M. J. Heney, New Whatcom, Wash., work to begin about May 1. An engineering party under Geo. M. Rice is locating the line, which will largely follow the survey of the Drayton Harbor, Lynden & Spokane Falls, and not much work will be done until the location has made some progress.

PORTLAND, VANCOUVER & NORTHERN.—Incorporated in Oregon to build a railway from Portland to Vancouver; capital stock, $3,000,000; incorporators: Wm. H. Schofield, G. H. Durham, Robert T. Platt, Portland, Ore.

STREET AND ELECTRIC RAILWAYS.

MANCHESTER, N. H.—The council has given the street railway company until June, 1895, to construct a single trolley railway system in this city.

BURLINGTON, VT.—The Queen City Park Association has granted the electric street railway company the right to extend its tracks to the park, and it is stated that the work will be done at once.

HOLYOKE, MASS.—The People's Electric St. Ry. Co. has been incorporated to build a line 9½ miles long; capital stock, $100,000; Treas., R. F. Kelton; W. F. Whiting, C. H. Curran, J. E. Delaney.

LOWELL, MASS.—The Lowell & Suburban St. Ry. Co. has been authorized to extend its tracks to Westford, Bedford, Burlington, and Wilmington, and also to supply electric power.

NATICK, MASS.—The Natick Electric St. Ry. Co. will extend its line to Hopkinton, and it is stated that the contract has been awarded at $40,000, the work to be commenced at once.

WESTFIELD, MASS.—R. D. Gillett, Clk., Highland St. Ry. Co., writes us that the contract for constructing the road has been awarded to C. D. Allen, Westfield, the company to furnish rails, ties, etc.

BROOKLYN, N. Y.—The Brooklyn City R. R. Co. has been granted franchises for extending its tracks in Flatbush and Flatlands.

LOCKPORT, N. Y.—We are informed that Reed & McKibbin, the contractors for building the Lock City Electric Ry., have been denied an extension of time for completing the railway.

NEWBURG, N. Y.—The Newburg & Orange Lake R. R. Co. has been incorporated to build a street railway 4½ miles long; capital stock, $100,000; directors, J. M. Wickey, W. H. Weston, B. B. Odell.

NIAGARA FALLS, N. Y.—The Niagara Falls & Lewiston Electric Ry. Co. is reported as arranging to commence the construction of its proposed line along the Niagara River. Pres., Capt. J. M. Brinker.

OWEGO, N. Y.—The Tompkins & Tioga County Traction Co. is preparing plans for an electric railway from Ithaca by way of Newfield, Danby and Spencer to this place, according to reports.

GLOVERSVILLE, N. Y.—W. L. Dougan, Troy, has been engaged to make a survey for an electric railway between this place and Mountain Lake, a distance of five miles. Elman Hilts, A. J. Zimmer and W. C. Mills are interested.

WHITE PLAINS, N. Y.—The Elmsford, White Plains & Mamaroneck R. R. Co. is being formed to construct an electric road between the places named; capital stock, $150,000.

BORDENTOWN, N. J.—The Central Jersey Traction Co. has petitioned the council for a franchise through this place to connect with Trenton.

CAMDEN, N. J.—The citizens of Gloucester county are reported as petitioning the Camden, Gloucester & Woodbury Electric R. R. Co. to extend its line to Clarksboro, Mulica Hill and Swedesboro.

POINT PLEASANT, N. J.—The South Jersey Ry. Co. has petitioned the council for a franchise for an electric railway; directors, Frank Brewer, West Orange; Dr. Henry Mandeville, South Orange; B. F. Cole, E. H. Murphy.

BALTIMORE, MD.—Frank H. Callaway has been granted a franchise for an electric railway along the Baltimore and Liberty Turnpike.

COVINGTON, KY.—The South Covington & Cincinnati St. Ry. Co. has awarded the contract for constructing its line between this place and Ludlow to J. Degnan & Co. at $80,000. The road will be four miles long and the construction will be commenced at once.

MARION, O.—The Electric St. Ry. Co. has been incorporated with a capital stock of $100,000; Pres. and Treas., Edward Durfee; Secy., Geo. Turney.

TOLEDO, O.—J. B. Uhl, who surveyed the proposed route for the Toledo, Monroe & Detroit Electric Ry., is reported as saying that the survey has been completed, and that the right of way has about all been secured. The company intends to begin the construction June 1.

OSHKOSH, WIS.—J. K. Tillotson, Toledo, O., has been granted a franchise for an electric railway in this city.

MOUNT PLEASANT, IA.—The Mount Pleasant St. Ry. Co. has been incorporated; Pres., Dr. G. E. Smith; Secy. and Treas., J. McCord.

KANSAS CITY, KAN.—The Quindaro Park Electric R. R. Co. has been incorporated to build a road 3½ miles long; capital stock, $200,000; J. P. Moore, C. C. Dail, L. F. Bird.

QUEBEC, QUE.—A company has been formed by J. B. Laliberte, J. N. Gregory, B. Leonard, and others, with a capital stock of $200,000, to construct an electric surface or elevated railway in this city.

ELEVATED RAILWAYS.

CHICAGO, ILL.—The Northwestern Elevated R. R. Co. has been granted the right to construct its proposed line between Monroe St. and North Ave.——It is reported that the Alley Elevated R. R. Co. is investigating the building of a spur from 50th St. to Cottage Grove Ave., and thence to 55th St. and east to Lake Ave.

HIGHWAYS.

TENNESSEE.—The Knox county pike commission proposes to construct about ten miles of roads this year, according to reports.

OHIO.—The clerk of Hamilton county has been directed to readvertise for bids for improving Carthage Pike. The itemized bids recently received for this work were published in our issue of April 26.

ARKANSAS.—Bids are asked until May 15 for constructing a road in Mineral township, Pulaski county. W. A. Compton, County Judge, Little Rock.

BRIDGES AND TUNNELS.

BROOKLINE, MASS.—Bids are asked until May 22 for an iron foot bridge about 100 ft. in length. Address the park commissioners. A. H. French, Engr.

HOLYOKE, MASS.—The city has been authorized to issue $150,000 in bonds to pay its share of the cost of a bridge across the Connecticut River to Williamsett.

PHILADELPHIA, PA.—Appropriations have been made for the following bridges: Over the Schuylkill at the Falls, $300,000; Girard Ave., over Pennsylvania Ave., $28,000; 49th St., over West Chester & Philadelphia R. R., $25,000; 17th St., $50,000; Duval St., $50,000, Sixth St. and Alleghaney Ave., $80,000; Torresdale Ave., $90,000.

PITTSBURG, PA.—The council has ordered the construction of the proposed bridge over the Monongahela River from South 22d St. to Forbes St.

BALTIMORE, MD.—The mayor has signed the ordinance appropriating $27,000 for a bridge over Gwynn's Falls on the line of Columbus Ave. Other work is under consideration.

BILOXI, MISS.—The bill authorizing the Biloxi & Back Bay Bridge Co. to construct a drawbridge across Back Bay has been approved by the secretary of war and favorably reported by the house committee.

OCEAN SPRINGS, MISS.—A company is being formed to construct a bridge across Fort Bayou; capital stock, $10,000; Pres., Parker Earle; Secy., E. R. Bragg.

CINCINNATI, O.—Bids are asked until May 26 for the construction of substructure, superstructure and approaches of Venice bridge, Colerain township. Fred Bader, Pres. Comrs., Hamilton county.

DAYTON, O.—The city engineer has reported that it will cost $57,000 to make necessary repairs and to construct a new bridge at Main St. A bridge is also desired across the Miami River at Apple and Albany Sts.

SPRINGFIELD, O.—Bids are asked by the trustees of the water-works until May 24 for a 100-ft. span iron or steel bridge, as stated in our advertising columns. Consult. Engr., J. D. Cook, Toledo.

CHICAGO, ILL.—Capt. W. L. Marshall, U. S. Engineer Office, informs us that the following bids were received May 1 for swing bridges near Milan, Ill., the price in the first column being for a single track railway bridge and the second column for a highway bridge; $500,000 is available for this work:

Mo. Valley B. & I. Wks., truss, steel	$8,949	$5,149
Chicago B. & I. Wks., high truss, steel	7,494	3,994
F. C. McMath, Detroit, riv. truss, triang., steel	8,621	5,841
Wisconsin B. & I. Co., pin connected truss, steel	7,830	4,970
Mount Vernon Bridge Co., riveted truss, steel	9,700	5,450
Am. Bridge Wks., Chicago, truss, steel and iron	7,825	4,725
C. L. Strobel, Chicago, pin connected truss, steel	8,200	5,100
" " " riveted truss, steel	8,200	.....
" " " plate girder, steel	8,650	.....
Youngstown B. Co., girder, steel and iron	9,100	4,335
" " truss, steel and iron	8,340	.....
Phoenix Bridge Co., steel	8,904	5,326
A. & P. Roberts Co., Phila., pin con. truss, st'l	11,275	6,760
King Bridge Co., truss, steel and iron	6,955	4,245
Toledo Bridge Co., truss, steel	7,888	4,748
New Jersey Steel & Iron Co., truss, steel	10,083	6,618
Milwaukee B. & I. Wks., truss, steel and iron	8,700	4,900
Wrought Iron Bridge Co., not stated	10,300	7,935

EAST WHEATLAND, ILL.—Bids are asked until May 16 for the masonry and superstructure of a 150-ft. span steel highway bridge, 16-ft. roadway. Engr., O. R. Rauchfuss, Joliet. A. S. Clow, Town Clk.

WEST DULUTH, MINN.—The president has approved the bill authorizing the construction of a bridge across the St. Louis River at this place.

EUREKA SPRINGS, ARK.—There is talk of a bridge across the Kings River at this place.

AUSTIN, TEX.—Press reports state that a storm April 29 carried away one span of the bridge at the Granite Mountain, a bridge at Marble Falls, 60 miles west of this city, and two spans of the bridge over Delaware Creek, west of Burnett.

EVERETT, WASH.—N. D. Miller, Ch. Engr., Great Northern Ry., St. Paul, writes us that the construction of the proposed tunnel at this place has not been decided upon, but press reports continue to state that contractors are preparing bids for the Great Northern tunnel at this city; the tunnel to be 2,000 ft. long, 30 ft. wide and 30 ft. high, and the work requiring 5,200,000 brick, 54,000 cu. yds. of masonry and 2,000,000 ft. of timber.

OTTAWA, ONT.—Bids are asked until May 14 for the construction of a steel bridge, composed of one swing span of 187 ft. and a fixed span of 22 ft., to carry the Canada Atlantic Ry. over the Soulanges Canal and public highway. J. H. Balderson, Secy. Dept. Rys.

WATER-WORKS.

NEWPORT, N. H.——D. J. Mooney, Clk. Comrs., writes us that plans for works will be completed about May 15 and that the material is being bought direct from the manufacturers. There will be about 10 miles of pipe and the works will be a gravity system, with earth reservoir. Trenching and pipelaying will be done by contract.

BENNINGTON, VT.—The Bennington Water Co. is reported as arranging for an additional supply from a stream in Stamford, 7 miles from the reservoir. An 8 to 6-in. pipe will be laid.

WINDSOR, VT.—As a result of the fever epidemic it is stated that a new pumping system will be adopted and the old reservior abandoned.

GREENFIELD, MASS.—The commissioners have decided in favor of raising the dam of the present reservoir 14 ft., at a cost of about $15,000.

LEOMINSTER, MASS.—The town has voted to borrow $21,000 for new water pipe and $6,000 for sewers.

MONSON, MASS.—The town has been authorized to take a supply from Conant Brook.

NEWTON, MASS.—The council has authorized an expenditure of $77,000 for increasing the supply.

SOUTHBRIDGE, MASS.——The Southbridge Water Supply Co. has been authorized to increase its capital stock and to take an additional source of supply.

DOLGEVILLE, N. Y.—Bids are asked until May 25 for constructing works, as stated in our advertising columns. Alfred Dolge, Pres. Comrs.

EARLVILLE, N. Y.—The citizens are reported as considering plans for works.

LOWVILLE, N. Y.—David M. Green, Troy, is preparing specifications for works. It is stated that the commissioners will purchase the material and contract for the pipelaying.

NEW YORK, N. Y.—Preliminary plans have been adopted for the proposed reservoir at Jerome Park and steps are now being taken toward securing the necessary land.

RICHMONDVILLE, N. Y.—It is stated that works will be built this summer.

TROY, N. Y.—The commissioners have adopted the plans for the proposed new gravity supply from near Grafton, estimated to cost $700,000, and have appointed Richard F. Hall superintendent of the construction.

VALATIE, N. Y.—The material is being purchased, according to reports, and the construction of the works will be commenced about June 1.

NORTHAMPTON, N. J.—The Citizens' Water Co. has been incorporated to construct works; capital stock, $75,000; A., A. A. and H. M. Anderson, R. C. Barrington and others.

SEWELL, N. J.—F. J. Auspach's water-works, including windmill, tanks, etc., were destroyed by fire last week, at a loss of over $5,000.

GREENCASTLE, PA.—It is reported that the citizens are debating whether to grant a franchise or to construct works.

LEBANON, PA.—The committee has decided to recommend the construction of additional storage reservoirs.

PHILADELPHIA, PA.—Bids are asked until May 15 for engine house, boiler house, 48-in. pipe, valves, etc.; also for building stone and an electric traveling crane. J. H. Windrim, Dir. Pub. Wks.

QUARRYVILLE, PA.—Bids are asked until May 22 for constructing works, as stated in our advertising columns. W. U. Hensel, Pres.

LONACONING, MD.—The election May 1 resulted in favor of works, 264 to 77, and the construction will soon be commenced by White & Hallock, Wheeling, W. Va., to whom a franchise was recently granted, as stated in these columns.

FLORENCE, S. C.—Bids are asked for leasing an artesian well, as stated in our advertising columns. W. W. Hursey, Mayor.

COLUMBUS, GA.—The company has offered to extend the works into the annex if the city will contract for 18 fire hydrants at $75 per year each.

QUINCE, GA.—The post-master writes us that the report concerning works is incorrect and that no works are needed.

MADISON, FLA.—The $16,000 of water-works bonds have been sold to B. C. Lewis, Tallahassee, at 98 cts.

STARKE, FLA.—It is reported that this place wants works.

NASHVILLE, TENN.—The committee is considering the adoption of the meter system.

NEW ORLEANS, LA.—Bids are asked until May 28 for a new supply for the U. S. Marine Hospital, as stated in our advertising columns. Jas. M. Gassaway, Custodian.

MORGANFIELD, KY.—The election April 30 resulted 321 in favor and 17 against works.

SHELBYVILLE, KY.—The franchise for works and electric lights has been sold to the Shelbyville Water & Light Co.

SOUTH CARROLLTON, KY.—It is reported that the town will accept a proposition from a citizen of Nashville for putting in works.

ATTICA, O.—The legislature has been petitioned for authority to issue $10,000 in bonds for new works.

McBAIN, MICH.—O. O. Dunham, Clk., writes us that a committee has been appointed to secure estimates for works, but that no contracts have yet been awarded.

CAREZ, O.—The citizens have voted to issue $25,000 in bonds for works, for which plans will now be prepared. W. H. Houk, Cy. Clk.

HURON, O.—It is stated that works will soon be constructed.

STEUBENVILLE, O.—Bids are asked by trustees until May 24 for constructing works, as stated in our advertising columns. Engr., Wilkins & Davison, Pittsburg, Pa.

WHITING, IND.—The contract for the water-works intake has been awarded to Remington & Co., Chicago. J. H. Brown, Supt.

CHEBOYGAN, MICH.—The city has voted to issue $23,700 in bonds for improving the works.

KALAMAZOO, MICH.—The committee has recommended an appropriation of $6,000 for the purchase of 500 meters.

LAKE ANN, MICH.—An election will be held May 10 to vote on issuing $4,000 in bonds for works.

ASTORIA, ILL.—Plans are being considered for works, according to reports.

CARLYLE, ILL.—The city has settled the water-works suit by purchasing the works for $26,000. The works were built in 1887 at a cost of $30,000, but the city claimed that the required pressure was never furnished.

BODE, IA.—The citizens have voted to issue bonds for works, including 6-in. mains and an elevated tank.

BRITT, IA.—The city recorder writes us that plans for works will soon be ready; population, 1,500. Engr., Fremont Turner, Des Moines.

GRISWOLD, IA.—The contract for works has been awarded to the Fremont Foundry & Machine Co., at $5,890, as stated last week.

JEFFERSON, IA.—The council is considering the question of works, for which $12,000 was recently voted.

MINNESOTA LAKE, MINN.—Bids are asked until May 15 for constructing works, including tank, windmill tower, well, etc. T. M. Keegan, Recorder.

ST. JAMES, MINN.—The citizens have voted to issue $30,000 in bonds for works and electric lights.

CHERRYVALE, KAN.—The Cherryvale Water Co. has been incorporated by J. C. McMurray, Worcester, Mass.; J. M. Courtney, O. F. Carson and others; capital stock, $50,000.

CREIGHTON, NEB.—The contract for works has been awarded to the U. S. Wind Engine & Pump Co., Batavia, Ill., at $7,570.

DELL RAPIDS, S. DAK.—G. R. Krause, Cy. Audr., writes us that the contract for constructing works has been awarded to C. W. Hubbard, Sioux Falls, at $10,-590. There were six other bidders, including the U. S. Wind Engine & Pump Co.; Fairbanks, Morse & Co., Iowa Construction & Mfg. Co., W. H. Wheeler & Co. and others. The other bids ranged from $11,740 to $16,000.

GLASGOW, MO.—There were only five votes against putting in works at the election last week.

SPRINGFIELD, MO.—Bids are asked until May 24 for a 10,000,000-gallon pumping engine, 1,708 tons 24-in. pipe, etc., as stated in our advertising columns. E. C. Gwyn, Pres. Bd.

EASTLAND, TEX.—Works are to be put in, according to reports.

NORMAN, OKLA.—Plans for works, to cost $20,000, have been prepared by Richard Nevins, Jr., Cy. Engr., Perry.

PERRY, OKLA.—It is stated that the construction of the proposed works will soon be commenced; estimated cost, $50,000. Richard Nevins, Jr., Cy. Engr.

DENVER, COLO.—The Wolfe Drain & Water Supply Co. has been incorporated by Jas. Wolfe, John McArtney and Symph Ogilvy; capital stock, $5,000.

FORT COLLINS, COLO.—Hendrie & Bolthoff, Denver, have been awarded the contract for a new boiler and pump, at $1,485.

VICTOR, COLO.—The Victor Water & Gravity Co. has been incorporated by I. E., J. B. and F. R. Downey; capital stock, $50,000.

EAST LAS VEGAS, N. MEX.—The trustees are considering a renewal of the franchise granted to H. S. Raymond last year for works.

PUYALLUP, WASH.—An ordinance has been introduced proposing to issue $60,000 in bonds for works.

SPOKANE, WASH.—Plans are being considered, according to reports, for a 15,000,000-gallon reservoir, estimated to cost $80,000.

EAST COTTAGE GROVE, ORE.—Bids are asked until June 1 for $5,000 of 20-year 7% water bonds. J. C. Stanner, Cy. Recdr.

SAN FRANCISCO, CAL.—Bids are asked until May 22 for supplying this city and county with 30,000,000 to 60,000,000 gallons of water daily. John A. Russell, Clk. Jas. Denman, Chn. Com.

SAN DIEGO, CAL.—Jos. A. Flint has been appointed receiver of the San Diego Water Co.

HARTLAND, N. B.—It is stated that $3,500 will be spent at once for works.

ALEXANDRIA, ONT.—Potter & Folwell, Pittsburg, Pa., have been engaged to prepare plans for works.

ARTESIAN WELLS.

BOONE, IA.—R. M. Mitchell, Cy. Engr., informs us that the contract for sinking an artesian well has been awarded to J. B. Miller & Co., Chicago. The bids will be published next week.

HUBBARD, TEX.—The artesian well has been completed to 2,000 ft., and efforts are being made to raise funds for sinking it 500 ft. further.

IRRIGATION.

TACOMA, WASH.—Press reports state that L. C. Dilman, of Spokane, is in the city maturing a scheme for developing central Washington and offering work to all the unemployed laborers in the state. The scheme is to dig three big irrigating ditches and pay the employees their board, clothing and other expenses and the balance of their wages in interest-bearing bonds secured by land along the ditches. Mr. Dilman has two associates, J. M. Buckley, Spokane, and W. H. Smith, of this city. They have an option on 90,000 acres of Northern Pacific R. R. land in central Washington and propose that the chambers of commerce of Tacoma, Seattle and Spokane shall each appoint one person, the six making a board of directors, to manage the company's affairs. The company, if organized, is to contract for the purchase of these 90,000 acres and at once sell enough on long installments with a small cash payment to lay in sufficient tools and provisions to set the men at work. One ditch will extend from Priest Rapids towards Prosser Falls, on the west side of the Columbia River, and irrigate 30,000 acres; the second, from Walluia to Akiusworth, irrigating 15,000 acres, and the third leaves Snake River near Riparia, at the crossing of the Union Pacific Ry., and traverses the Eureka flat through 45,000 acres.

OAKDALE, CAL.—The Oakdale Irrigation Co. has authorized an expenditure of $12,000 for a crib dam.

RIVERSIDE, CAL.—Geo. M. Pearson, County Surv., has prepared plans for a new ditch for the South Riverside Water Co., according to reports.

NEW COMPANIES.—Elk Bayou Ditch Co., Visalia, Cal.; $10,000; M. M. Burnett, Tulare; H. P. Perkins, Thos. Creighton.——Paxton Irrigation Co., Keith county, Neb.; $5,000; G. F. Cooper, A. J. Sheridan.——Riverside Irrigation Co., Roswell, Idaho; $150,000; Judson Spofford, W. P. Haru, A. J. Wiley, Boise City.——Farmers' Union Ditch Co., Star, Idaho; $50,-000; Pres., S. S. Foote, Middleton; Secy., P. S. Farmer, Dry Creek.——Kearnes Lateral Irrigation Ditch Co., Greeley, Colo.; $100.

SEWERS.

PORTSMOUTH, N. H.—The city will spend $26,000 this year for sewers. S. R. Gardner, Cy. Clk.

FARMINGHAM, MASS.—Press reports state that the local officials are taking of securing 10 acres of land for the filtration of the underdrain water, the disposal of which has caused much discussion.

MEDFORD, MASS.—T. Howard Barnes, Cy. Engr., informs us that the following contracts have been awarded for material and labor on sections 5, 6, 7 and 8 of the sewerage system: Brick, Bay State Brick Co., Boston; cement, W. G. Nash, Boston; pipe, Portland Stone Ware Co., Boston; manhole frames and covers, Union Iron Works, Lynn; labor on sections 5 and 6, G. Cenedella, Milford; on 7 and 8, Gennaro, Long & Little, South Braintree. The bids are published under Contract Prices.

PITTSFIELD, MASS.—Bids are asked until May 14 for constructing about 12,500 ft. of 18 to 6-in. pipe sewer; also for furnishing pipe, brick, etc., as stated in our advertising columns. Ernest W. Bowditch, Engr.

NEW HAVEN, CONN.—Lawrence O'Brien has been awarded five contracts for sewers at $8,097.

WALLINGFORD, CONN.—The city has voted to build sewers in three streets.

AVON, N. Y.—The commissioners have engaged S. D. Backus, Canandaigua, to make surveys and plans for proposed work.

BROOKLYN, N. Y.—The governor has signed the bill allowing the city to spend $2,000,000 for constructing sewers.

BUFFALO, N. Y.—Bids are asked until May 15 for constructing 18 to 10-in. brick sewers in four streets. J. E. Ransom, Secy., Pub. Wks.——The lowest bid for constructing a 24 to 15-in. brick sewer was that of Frank Cobb, at $11,413. The following bids were received by the board of public works on May 1 for constructing sewers in Abbott Road, Selfert, Peck and Pulaski Sts., respectively:

William F. Barnes	....	$1,999	....	$705
L. K. Suor	$7,000	2,000	....	750
August Gisel	6,960	1,888	$1,070	743
Henry Harter	7,572	2,209	1,948	855
Jacob Ritzman	7,078	2,024	1,156	748
Charles W. Werlin	6,856	2,055	1,295	762
Fred. J. Martin	5,998	1,925	1,186	700
Elmer Mighton	6,010	1,804	1,350	720
W. G. Smith	6,999	2,226	2,000	784
Henry Kebbin	6,930	1,999	1,335	800
O. Knobloch	....	2,013	....	751
Harrer & Hess	5,898	2,000	1,060	900
John Munn	6,455	1,916	1,268	810

ROCHESTER, N. Y.—The city surveyor has been directed to advertise for bids for constructing an outlet sewer in Thomas St.; estimated cost, $25,000.

TROY, N. Y.—Bids are asked until May 15 for a 12-in. pipe sewer in Fifteenth St. E. Ogden Ross, Secy. Bd.

UTICA, N. Y.—The city surveyor has been directed to prepare plans for constructing a sewer in Kemble St.

ELIZABETH, N. J.—Bids are asked until May 25 for constructing 1,650 ft. of 24-in. pipe sewer in Livingston St. N. K. Thompson, St. Comr.

WOODBURY, N. J.—Plans and specifications for a system are being prepared and it is reported that the council will soon take steps for the construction.

PITTSTON, PA.—Potter & Folwell, Pittsburg, have been engaged to make surveys and plans for a complete system. The surveys will be commenced at once, and it is hoped that part of the system will be constructed this season.

BALTIMORE, MD.—Ordinances have been introduced in the council appropriating $42,000 for sewers in two streets.

PORTSMOUTH, VA.—It is reported that active work on the sewerage system will commence within a few days. The work is to be finished in two years and to cost $100,000. W. T. Brooke, Cy. Engr., Norfolk, is the consulting engineer.

TAMPA, FLA.—The council is again discussing the question of constructing a system, the plans for which were made last year by Geo. E. Waring.

HENDERSON, KY.—Geo. E. Waring, Newport, R. I., is engaged in making plans for a system, and it is thought that $10,000 to $30,000 will be spent this year on the construction.

BOWLING GREEN, O.—The question of improving the sewerage system is being considered.

FRANKFORT, IND.—Bids are asked until June 1 for constructing the main sewer noted last week according to reports. A. J. Hammond, Cy. Engr.

INDIANAPOLIS, IND.—Contracts will be awarded this month for constructing 5,044 ft. of sewers, and plans are now being prepared for additional sewers in 16 streets.——Work is now being done on sewers to cost $1,088,294.

SAGINAW, MICH.—The board of public works has voted in favor of constructing sewers in 14 streets; estimated cost, $54,410.

MINNESOTA LAKE, MINN.—It is stated that bids will be received until May 15 for constructing a system of sewers. Thos. M. Keegan, Recorder.

LYONS, IA.—Plans are being considered for a system of sewers for the entire district south of Main St.

KANSAS CITY, KAN.—C. A. Ellis, Cy. Engr., has completed plans for sewers estimated to cost $12,000.

BENTON, ARK.—It is reported that Col. Uriah Lott proposes to build a sewer system in this place to cost $5,000.

WACO, TEX.—Bids are to be asked for extending the sewer system, the contractor to accept city bonds in payment. W. C. Cooper, Cy. Engr.

STREETS.

BURLINGTON, VT.—The "Free Press" suggests that the city take immediate steps towards repaving the streets, and that $20,000 be spent each year for five years for this purpose.

BROOKLYN, N. Y.—The governor has signed the bill authorizing the city to spend $1,500,000 during 1894 and 1895 for paving with granite blocks.

MIDDLETOWN, N. Y.—Bids are asked until May 21 for paving with asphalt blocks and brick, as stated in our advertising columns. E. M. Hamilton, Cy. Clk.

MOUNT VERNON, N. Y.—The commissioner of public works has been directed to prepare plans for paving Fifth Ave., from First to Sixth Sts., with asphalt; estimated cost, $40,000.

ROCHESTER, N. Y.—The council has adopted ordinances for paving two streets with brick; estimated cost, $18,000.——The lowest bid received for paving Scio St. with asphalt was from the Rock Asphalt Pavement Co., at $8,057; the other bidders being: Warren-Scharf Asphalt Paving Co., $8,178; Rochester Vulcanite Pavement Co., $8,628; Chambers & Casey, $10,-884; estimate, $11,300.

SCHENECTADY, N. Y.—Bids are asked until June 12 for paving about 2,000 sq. yds. of South Centre St. with asphalt. Lewis B. Sebring, Cy. Engr.

TROY, N. Y.—Bids are asked until May 15 for paving Franklin St. with brick on concrete. E. Ogden Ross, Secy. Bd.

PHILADELPHIA, PA.—Bids are asked until May 15 for paving private streets with granite blocks. M. Veale, Health Officer.

WILLIAMSPORT, PA.—The opening of bids for paving Pine and Third Sts. has been delayed for a week.

BALTIMORE, MD.—Ordinances have been adopted for paving and curbing 13 streets.

LOUISVILLE, KY.—Contracts have been awarded for paving sidewalks in 15 streets as follows: Louisville Artificial Stone Co., 2 streets, $6,200; Hexagon Tile Walk Co., 5 streets, $7,400; American Granite Co., 4 streets, $6,000; Falls City Artificial Stone Co., 4 streets, $8,200.

AVONDALE, O.—Bids are asked until May 28 for improving Harvey Ave. W. E. Wynne, Village Clk.

MIDDLETOWN, O.—The Middletown Paving Co. has been incorporated with a capital stock of $25,000.

NORWOOD, O.—Bids are asked until May 12 for macadamizing Monroe Ave. Engr., J. M. Harper, Cincinnati.

ANDERSON, IND.—Fries, Barr & Moulden, Greenfield, are reported as having been awarded the contract for constructing about 10 miles of streets and sidewalks, to cost about $67,000.

INDIANAPOLIS, IND.—The board of public works estimates that contracts for 10,870 lin. ft. of paving with asphalt, brick and cement will be awarded this month.——The city engineer is reported as making plans for paving 44 streets.

DETROIT, MICH.—The lowest bid for paving four streets with cedar blocks on concrete was that of the Talbot Paving Co., at $88,622.

PEKIN, ILL.—Bids are asked until May 25 for paving with brick, as stated in our advertising columns. U. J. Albertsen, Chn. Com.

MILWAUKEE, WIS.—The board of public works will advertise for bids this month for paving several streets with asphalt, according to reports.

ST. CHARLES, MO.—The mayor has advised the council to ascertain the best material for paving Main St.

HOUSTON, TEX.—Bids are asked until May 14 for paving Texas Ave. with brick. J. T. Browne, mayor.

TORONTO, ONT.—H. D. Ellis, Roadway Engr., informs us that the bids for paving Queen St. with Trinidad asphalt ranged from $72,900 to $74,372. The work includes 17,395 sq. yds. asphalt on 6 ins. concrete foundation, 367 sq. yds. Scoria blocks reset in mortar, 312 sq. yds. Scoria blocks on 6 ins. concrete foundation, 10,863 lin. ft. straight 4-in. stone curbing, 163 lin. ft. circular 6-in. stone curbing, 12 lin. ft. circular stone curbing, 2 ft. radius, 11,438 lin. ft. gutter stone on 6 ins. concrete foundation, and 4,088 lin. ft. crossing stone, 14 ins. × 5 ins., on 6 ins. concrete foundation.

WINNIPEG, MAN.—The street committee has recommended that 11 streets be macadamized, length 26,730 ft., estimated cost $75,468, and that 15 streets be graveled, length 11 miles, estimated cost $81,166. The city engineer has recommended that Main St. be paved with brick, at an estimated cost of $60,000 to $75,000.

ELECTRIC LIGHT AND POWER.

McKEESPORT, PA.—The committee has advertised for bids for an electric light plant, according to reports.

FOSTORIA, O.—It is reported that the business men are organizing an electric lighting company.

MOUNT GILEAD, O.—The council has granted a 20-year franchise for electric lights to Dennison & Guewyn, Delaware, O., but has not contracted for lighting. Propositions from others are asked. Geo. J. Young, Cy. Clk.

LAPEER, MICH.—It is reported that the council is about to advertise for bids for 20 lights for five years.

NEWBERRY, MICH.—Bids are asked until June 4 for constructing an electric light and pumping plant

for the Upper Peninsular Asylum. C. W. Chase, Chn. Com.

CUBA, N. Y.—A committee has been appointed to investigate the question of putting in an electric light plant.

FILLMORE, N. Y.—It is reported that T. J. Campbell, Wiscoy, is making arrangements to put in an electric light plant to furnish light to this place and Hume.

JAMESTOWN, N. Y.—The board of public works has been directed to make plans for the construction of two electric light circuits for commercial purposes.

MONTROSE, N. Y.—The council has appointed a committee of four to investigate the question of putting in an electric light plant. The Consumers' Water Co. has offered to erect a plant if the village will pay $800 a year for ten arc lights. J. H. Corwin.

OVID, MICH.—Bids are asked until May 15 for constructing an electric light and power plant. A. S. A. S. Rose, Village Recdr.

WAUKEGAN, ILL.—Bids are asked until May 14 for 80 arc lights for three to five years. Henry Thacker, Cy. Clk.

LANCASTER, WIS.—The city is reported as having granted an electric light and power franchise.

MILWAUKEE, WIS.—Aldermen Muenzberg, Rademaker and Renning are members of a committee appointed to investigate the question of a municipal electric light plant.

ST. JAMES, MINN.—The village has voted to issue $30,000 in bonds for an electric light plant and for water-works.

GRAND ISLAND, NEB.—Bids are asked until May 16 for 25 arc lights of 2,000 c. p. for one year. C. W. Brininger, Cy. Clk.

MONTREAL, QUE.—The power house of the Royal Electric Light Co. was destroyed by fire May 1; loss, $100,000.

NEW COMPANIES.—Bluestone Electric Light Co., Bramwell, Va.; $50,000; John Cooper, J. P. Bowen, Jenkins Jones.——Greene County Electric Co., Roodhouse, Ill.; $30,000; E. M. Prindle, Hamden Kelsy, J. A. Blaurock.——Crescent Electric Co., Chicago, Ill.; $10,000; W. H. Adams, Chas. Cohenaur, Bernard Elshoff.——Rose Electric Co., St. Louis, Mo.; $40,000; P. L., A. E., and Matilda Rose.——Chesley Electric Co., Hoboken, N. J.; $100,000; W. S. Chesley, W. B. Gillmore, C. J. Donohue, Jersey City.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

STEAM PLANT.—San Angelo, Tex.—Bids are asked for a steam plant, as stated in our advertising columns. W. A. Guthrie, Secy.

ELECTRIC TRAVELING CRANE.—Philadelphia, Pa.—Bids are asked until May 15 for an electric traveling crane. Jas. H. Windrim, Dir. Pub. Wks.

IRON WORK, ETC.—Cincinnati, O.—Bids are asked until June 5 for the brick work, stone work, iron work, etc., for the main structure of the proposed new university building. Archs., Samuel Hannaford & Sons, Hulbert Block.

DRAINAGE DITCH.—Elk Point, S. Dak.—It is stated that a drainage ditch is to be constructed from Norwegian Lake four miles northwest to the Sioux River. The main ditch will be 18 ft. wide at the top and 6 ft. at the bottom and 5 ft. deep.

BUILDING.—Lawrence, Kan.—The state board of public works has awarded the contract for the construction of the building for physics and electrical engineering at the state university to C. H. Holcraft, Topeka, at $36,933. The legislature of 1893 appropriated $50,000 for the construction and equipment of the building.

BIDS ASKED.

Trenching and pipelaying, Syracuse, N. Y., until May 11
Advertised in Engineering News, May 3.
Paving, New Castle, Pa., until.....May 12
Advertised in Engineering News, May 3.
Street improvements, Madison, O., until.....May 12
Macadamizing, Norwood, O., until.....May 12
Stone curbing, Van Wert, O., until.....May 12
Paving, Davenport, Ia., until.....May 12
Sewer materials, Pittsfield, Mass., until.....May 14
Advertised, Engineering News, May 3 and 10.
Sewers, Pittsfield, Mass., until.....May 14
Advertised, Engineering News, May 3 and 10.
Lighthouse supplies, Tompkinsville, N.Y., until May 14
Advertised in Engineering News, May 3.
Water supply, Berwick, Pa., until.....May 14
Advertised, Engineering News, May 3 and 10.
Cement walks, Bond Hill, O., until.....May 14
Electric lighting, Waukegan, Ill., until.....May 14
Paving, Marshalltown, Ia., until.....May 14
Paving, Houston, Tex., until.....May 14
Bridge, Ottawa, Ont., until.....May 14
Sewers, Buffalo, N. Y., until.....May 15
Sewers, New Brighton, N. Y., until.....May 15
Cast iron pipe, 48-in., Philadelphia, Pa., until..May 15
Electric crane, etc., Philadelphia, Pa., until..May 15
Paving, Philadelphia, Pa., until.....May 15
Water-works, Aiken, S. C., until.....May 15
Jail, Blackshear, Ga., until.....May 15
Electric plant, Ovid, Mich., until.....May 15
Sewers, Le Mars, Ia., until.....May 15
Advertised in Eng. News, April 26, May 3.
Sewers, Minnesota Lake, Minn., until.....May 15
Water-works, Minnesota Lake, Minn., until....May 15
Highway, Little Rock, Ark., until.....May 15
Artesian wells, Ennis, Tex., until.....May 15
Electric lighting, London, Ont., until.....May 15
Sewer, Troy, N. Y., until.....May 15
Paving, Troy, N. Y., until.....May 15
Bridge, East Wheatland, Ill., until.....May 16
Electric lighting, Grand Island, Neb., until....May 16
Cast iron pipe, Cleveland, O., until.....May 17
Sewers, Brunswick, Me., until.....May 17
Advertised, Engineering News, May 3 and 10.
Sewer materials, Brunswick, Me., until.....May 17
Advertised, Engineering News, May 3 and 10.
Paving, Cincinnati, O., until.....May 18
Macadamizing, Pleasant Ridge, O., until.....May 18
Railway, 20 m., Texas Midland, Terrell, Tex..May 19
Laying sewer pipe, Concord, N. H., until.....May 21
Advertised in Engineering News, May 3.
Paving, Middletown, N. Y., until.....May 21
Advertised in Engineering News, May 10.
Bridge, Renfrew, Ont., until.....May 21
Bridge, Calais, Ont., until.....May 22
Advertised in Engineering News, May 3.
Bridge, Brookline, Mass., until.....May 22
Water-works, Quarryville, Pa., until.....May 22
Advertised, Engineering News, May 10 and 17.
Water tower, Peoria, Ill., until.....May 22
Advertised in Engineering News, May 3.
Water supply, San Francisco, Cal., until.....May 22
Excav., etc., Gov't. Bldg., Savannah, Ga. until..May 23
Advertised, Engineering News, May 3 and 10.
Life-saving station, Charleston, S. C., until...May 24
Advertised, Engineering News, May 10 and 17.
Bridge, Springfield, O., until.....May 24
Advertised, Engineering News, May 10 and 17.
Pump'g eng., pipe, etc., Springfield, O., until..May 24
Advertised, Engineering News, May 10 and 17.
Water-works, Steubenville, O., until.....May 24
Advertised, Engineering News, May 10 and 17.
Water-works, Dolgeville, N. Y., until.....May 25
Advertised in Engineering News, May 10.
Sewers, Elizabeth, N. J., until.....May 25
Paving, Pekin, Ill., until.....May 25
Advertised in Engineering News, May 10.
Bridge, Cincinnati, O., until.....May 26
Street improvements, Avondale, O., until.....May 28
Paving, Dayton, O., until.....May 28
Water supply, Marine Hosp., N. Orleans, La...May 28
Advertised, Engineering News, May 10 and 17.
Water-works, Danville, Ky., until.....May 30
Advertised in Engineering News, May 3 to 24.
Electric lighting, Jackson, Tenn., until.....June 1
Sewers, Frankfort, Ind., until.....June 1
Elevator, Gov't. Bldg., Galveston, Tex., until...June 1
Advertised, Engineering News, May 10 and 17.
Water-w'ks bonds, E. Cottage Grove, Ore., until June 1
Electric plant, Newberry, Mich., until.....June 2
Bridges, Fort Madison, Ia., until.....June 4
Government Bldg., Haverhill, Mass., until.....June 5
Advertised, Engineering News, May 10 and 17.
Iron work, etc., Univ. Bldg., Cincinnati, O., until June 5
Paving, Schenectady, N. Y., until.....June 12
Bridge, Hawkinsville, Ga., until.....June 13
Advertised in Eng. News, May 3 to June 7.
Water-works franchise, Florence, S. C.....No date.
Advertised in Eng. News, May 10 to 31.
Steam plant, San Angelo, Tex.....No date.
Advertised in Engineering News, May 10.

CONTRACT PRICES.

LEVEE WORK.—Memphis, Tenn.—Bids have been opened at the U. S. Engineer Office for 1,418,000 cu. yds. of levee construction on the lower Mississippi front, the lowest bidders being as follows: Australia levee, Tim Sullivan, 334,000 cu. yds., upper section at 9¾ cts., and lower section at 9½ cts.; Buckridge, Miss., to Chotard, W. L. Withers, 116,000 cu. yds., 10¾ cts.; Brunswick, Miss., upper section, L. Ashfennburg, 187,000 cu. yds., 11.74 cts.; lower section, James Carey, 202,000 cu. yds., 13⅜ cts.; Matthews levee, section 1, 126,000 cu. yds., Robert Johnson, 16¾ cts.; sec. 2, 162,000 cu. yds., Pat Lamb, 13¼ cts.; sec. 3, 133,000 cu. yds., Tim Sullivan, 9.98 cts.; sec. 4, 156,000 cu. yds., Robert Johnson, 11.99 cts.

IRON AND BRASS WORK AND GATES.—Portland, Ore.—The water committee has awarded contracts for furnishing the cast iron, wrought iron and brass work for the gate chambers of the four reservoirs, and also for 65 30 to 6-in. gates. There will be 130 tons of cast iron work, which will require special patterns; 80 tons of wrought iron work, and 7,500 lbs. of brass work. The bids for the cast iron ranged from 5.7 cts. to 10 cts. per lb.; for the wrought iron, from 5.9 cts. to 8.5 cts. and for the brass, from 17¼ cts. to 35 cts. per lb., and the contract for each was awarded to the Risdon Iron Wks., San Francisco, the lowest bidders. The contract for the 65 gates was awarded to John Barrett & Co., at $5,127.50, for the Galvin gates.

PUMPING ENGINES.—Reading, Pa.—I. C. Fetter, Secy. Comrs., informs us that the following bids were received May 1 for a 10,000,000-gallon compound condensing pumping engine, to work against a head of 300 ft., steam pressure of 90 lbs. and duty of 110,000,000:

Snow Steam Pump Co., Buffalo	$24,000 and $28,000
G. F. Blake Mfg. Co., New York	53,924
H. R. Worthington, New York	$32,500 and 35,500
F.R.Deavoe & Co.Nordberg).P't'b'g	$32,000 and 39,000
Holly Mfg. Co., Lockport, N. Y.	$44,000 and 53,000
E. P. Allis Co., Milwaukee.	$75,000, $60,000 and 38,000
Fraser & Chalmers, Chicago	$35,000
Groshon H. D. Pump Co..New York	$51,000 and 31,000
A. J. L. Loretz, Brooklyn	$37,000 and 29,500
Barr Pump Co., Philadelphia	$32,000

Columbus, O.—A. H. McAlpine, Supt. W. W., writes us that the city has awarded a contract for two 12,000,000-gallon pumping engines to the Holly Mfg. Co., at $103,000, the other bids being as follows: E. P. Allis Co., $91,000; Geo. F. Blake Mfg. Co., $100,000 and $113,000; Henry R. Worthington, $107,000. The first engine is to be completed within 9 months, and the second within 14 months from April 26, 1894.

SEWERS.—Meridian, Miss.—N. M. Brandon, Cy. Engr., has sent us a statement of bids received May 1 for the proposed system of sewers, column No. 1 being based on the bidder doing all work and furnishing all material except cement, and No. 2 upon the city furnishing cement, brick, iron pipe, manhole frames and covers, sewer pipe and Y branches, which are estimated to cost $41,052. The approximate total cost is about $95,000.

Bidder.	1.	2.
Howard Neeley	$71,043	$40,938
Kansas City B. & C. Co.	73,568	36,970
C. M. Rubush	73,280	.....
D. L. Wardroper & Co.	74,692	38,616
A. S. Johnson and N. Wingfield	77,111	.....
W. J. Irwin	81,259	46,546
M. J. Condon	81,511	.....
Gaubery, Noble & Wadley	83,522	49,220
Muir Bros. & O'Sullivan	87,886	.....
Guild & White	90,457	52,307
Van Sandt & Meeds	94,711	.....

The prices of the lowest bid, that of Howard Neeley, Chattanooga, Tenn., were as follows:

	1.	2.
Cast iron pipe, 100 tons, at	$25.00	$8.00
Brick masonry, 1,000 cu. yds.	4.00	1.25
6-in. stand-pipe connections, 500 ft.	30	15
38-in. brick sewer, 2,240 ft. (per foot)	2.15	1.15
36 " " " 2,200 "	2.05	1.10
30 " " " 1,310 "	1.90	1.10
28 " " " 480 "	1.90	1.10
24-in. pipe sewer, incl. Y's, 9,840 ft.	1.10	45
20 " " " " 2,370 "	90	40
18 " " " " 1,360 "	75	40
15 " " " " 2,880 "	62	37
12 " " " " 1,600 "	50	32
10 " " " " 6,510 "	40	27
8 " " " " 63,463 "	34	26
6-in. slants with stop'rs for bk. sewers	30	10
38-in. riveted steel pipe, 100 ft.	4.00	1.00
36 " " " " 100 "	4.00	1.00
30 " " " " 100 "	3.50	1.00
Manholes, complete, 304	23.00	10.00
Concrete, 1,000 cu. yds.	2.00	.....
Pine lumber, 10 M. ft. B. M.	20.00	.....
Rock excavation, 100 cu. yds.	1.00	.....
Extra excavation, 500 cu. yds.	60	.....
Pine lumber for sheeting, 10 M. ft.	15.00	.....
No. of working days to complete contract	150	.....

Rockford, Ill.—Charles E. Stowell, Cy. Engr., writes us that the contract for constructing sewers in the Fifth St. sewer district will be awarded to Thos. Tole, Rockford. The bids were as follows:

Bids Received at Rockford, Ill., for Sewers in the Fifth St. Sewer District.

Bidder.	20-in., 786 ft.	18-in., 724 ft.	18-in., c. iron, 24 ft.	15-in., 1,104 ft.	12-in., 4,378 ft.	9-in., 5,246 ft.	6 " 20-in., 16.	6 " 18-in., 12.	6 " 15-in., 20.	6 " 12-in., 102.	6 " 9-in., 154.	C'b'd manhole and c h b'm, 17.	Ordinary manhole, 1.	Lamp holes, 24.	Flush tank, 1.	Intakes, 31	Totals.
	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
Engineer's estimate	1.90	1.70	3.00	1.30	1.10	.75	1.25	1.00	.70	.50	.40	66.00	40.00	15.00	115.00	16.00	.....
E. C. Blake, Dubuque, Iowa	1.65	1.50	2.50	1.19	.85	.63	1.50	1.00	.60	.45	.30	45.00	30.00	10.00	95.00	18.00	12,611
Wilfred G. McConnel, Chicago	1.25	1.10	3.00	.90	.80	.70	1.25	1.00	.75	.50	.35	40.00	30.00	10.00	100.00	17.00	11,748
N. F. Reichert & Co., Racine, Wis.	1.40	1.10	3.00	.85	.75	.50	1.50	1.25	.75	.40	.30	45.00	35.00	8.00	65.00	12.00	10,384
Grimes & Moran, Elkhart, Ind.	.96	.89½	2.91½	.70	1-5	.56	.9	1.31	1.01	.77	.57	.41	49.45	32.56	12.27	84.70	11.88	9,059
Thomas Ennett, Rockford, Ill.	1.47	1.25	6.00	1.10	.80	.65	1.25	1.00	.62	.45	.40	8.35	39.15	17.10	90.00	25.25	12,967
A. Magnus, Elgin, Ill.	1.40	1.11	4.00	.82	.72	.56	1.40	1.00	.70	.46	.30	40.00	30.00	12.00	120.00	14.00	10,689
Rockford const'n Co., Rockford, Ill.	1.00	.90	2.50	.75	.63	.55	.90	.70	.45	.30	.20	60.00	40.00	14.00	70.00	15.00	9,993
Anderson & Lindquist, St. Paul, Minn.	1.40	1.25	4.00	.95	.75	.65	1.20	1.00	.75	.50	.30	65.00	35.00	15.00	100.00	22.00	12,269
C. W. Maynard, Maywood, Ill.	1.10	.92	1.95	.80	.72	.62	.88	.68	.49	.38	.24	48.00	35.00	15.00	100.00	11.00	10,625
Dubuque Const'n Co., Dubuque, Ia.	1.20	1.05	4.00	.85	.68	.51	1.00	.80	.60	.40	.25	45.00	35.00	15.00	100.00	22.00	10,449
Thomas H. Botham, Winona, Minn.	1.20	1.10	3.00	.85	.72	.79	1.80	1.65	1.05	.75	.55	60.00	45.00	25.00	125.00	12.50	12,458
Mail & Doan, Aurora, Ill.	1.05	.99	2.50	.86	.76	.70	1.21	1.12	.75	.60	.40	50.00	30.00	8.00	75.00	8.25	11,124
McNulty & Watson, Chicago	1.40	1.41	2.50	1.22	.90	.77	1.10	.90	.88	.68	.40	47.00	30.00	16.50	37.00	14.95	13,480
Hallstrom, Hanson & Lundberg, Rockford.	1.50	1.10	3.34	.90	.75	.55	2.10	1.80	1.20	.90	.60	55.00	50.00	10.50	100.00	12.50	11,206
Thomas Tole, Rockford, Ill.	1.25	.99	2.25	.67	.55	.39	.....	.....	.....	.....	.....	39.00	35.00	10.00	85.00	14.00	8,744
Kelley & Munsterman, Austin, Ill.	1.17	1.10	4.00	.95	.87	.73	1.05	.90	.60	.50	.35	50.00	30.00	.....	.....	10.00	11,834
M. Garretson & Co., Cincinnati	1.25	1.50	3.00	1.30	1.15	1.30	2.60	2.00	1.30	1.00	1.00	80.00	40.00	60.00	100.00	20.00	19,508

WATER-WORKS SUPPLIES, ETC.—Lancaster, Pa.—Contracts have been awarded by the water committee as follows: Trenching, Herman Schweers, at 15 cts. per cu. yd. for earth excavation and 35 cts. for rock; hauling pipe, Henry Wolf, at 35 cts. per gross ton; stop boxes, Wm. Wohlsen, at 3½ cts. per sq. ft.; pipe, Reading Foundry Co., at $22.85 per ton; pig lead, Marshall & Rengier, at 3.9 cts. per lb.; special castings, J. Thompson & Co., Philadelphia, at 2.1 cts. per lb.; stop valves, J. Thompson & Co., 4-in., $6.60; 6-in., $10.50; 8-in., $17; 10-in., $22.90; 12-in., $29; fire hydrants, J. Thompson & Co., 4-in., double nozzle, with two 2½-in. hose nozzles, frost case, complete, $21; 4-in., with one steamer and two 2½-in. hose nozzles and frost case, $23.75; ferrules, Flinn & Breneman, at 74 cts. each.

DREDGING.—Portland, Me.—Lieut.-Col. Peter C. Hains, U. S. Engineer Office, received the following bids April 21 for dredging, the price being in cents per cu. yd. measured in scow:

Bidder.	Portland Harbor, 150,000 cu. yds.	Bangor Harbor, 15,000 cu. yds.	High, 75,000 cu. yds.
Chas. W. Anthony, Fall River, Mass.	38.7	17.3	
Lynn Dredging Co., Lynn, Mass.	31	36	15½
Hamilton & Sawyer, Chebeague, Me.	27	..	..
Chas. H. Souther, Boston, Mass.	31	..	..
Moore & Wright, Portland, Me.	15¾	..	..

SEWER MATERIALS.—Baltimore, Md.—The following bids have been received for furnishing materials for the Patapsco St. sewer, for which $50,000 has been appropriated: Sewer blocks—Matthew Gault & Son, $123.99 per 1,000 or $3.60 per sq. yd.; Feaney & Peach, $109.25 and $2.95; James Peach & Bro., $119 and $3; Star Granite Co., $110 and $3; W. E. Cavey, $115 and $3.10; McClennahan & Bros., $125 and $3.45; Mystic Quarry Co., $132.49 and $3.78. Lumber—Stork & Co., Virginia pine $15 per 1,000 ft., white pine $22; P. M. Womble, $12.48 and $20.45; August Heinneman, $12.50.

and $22. Rubble stone—J. G. Schwind, $1.84 per cu. yd.; J. H. Atkinson, $1.74; J. G. Curley & Co., $1.59; Mystic Quarry Co., $1.65. Sand—Lydia E. Elliott, 65 cts. per cu. yd.; Frank Fallon, 72 cts.; J. J. Gallagher, 74 cts. Hand made brick—Daniel Donnelly & Sons, $7.60 per 1,000; Smith & Schwarz, $7.40. Cement—National Supply Co., Cumberland cement 97 cts. per bbl., and German Portland $2.38; B. Wallace & Co., Cumberland $1.25, Portland Joppa $2.70, Anson $2.65, North's $2.50; William W. Clarke & Son, Portland $2.39½; John Bullock & Sons, Round Top $1.05, Germania $2.60.

SEWERS.—Medford, Mass.—T. Howard Barnes, Cy. Engr., informs us that the following bids have been received for constructing sections 5 and 6, and portions of sections 7 and 8, of the sewerage system.

Bids Received for Constructing Sections 5 and 6 of the Medford, Mass., Sewerage System.

Quantities.	A. W. Bryce, Medford.	G. Conedella, Medford.	Ducey & Taylor, Boston.	J. J. Dorey, Somerville.	B. Falvey, Somerville.	Gennaro, Long & Little, So. Braintree.	J. Heath & Son, Lynn.	Lindsey & Cudmore, Somerville.	McCusker Brothers, Waltham.	D. F. McCarthy, Lawrence.	Mel'p'n Const'n Co., Boston.	Neill McBride, Brighton.	Marsh & Norton, Lawrence.	National Const'n Co., Boston.	D. O'Connell, Boston.	F. R. Page, Boston.	Weaving, Booth & Co., Medford.	N. White, Medford.
Earth excav., 0 to 8 ft., 13,330 cu. yds.	$ .70	$ .38	$ .75	$ .61	$ .70	$ .54	$ .63	$ .65	$ .55	$ .70	$ .94	$ .77	$ .60	$ .70	$ .74	$ .53	$ .90	$ .30
" " 8 " 14 " 3,960 "	1.00	.47	1.00	.75	1.10	.90	.85	.85	.95	1.00	1.00	.77	1.65	1.15	.95	.82½	.90	.50
" " 14 " 20 " 760 "	1.20	1.00	1.60	1.15	2.00	1.25	1.25	1.00	1.75	1.90	1.25	.77	2.40	1.70	1.50	1.45	.90	.75
Rock " 0 " 8 " 50 "	5.00	4.85	5.00	4.50	6.00	5.00	4.00	6.00	5.00	4.00	.10	5.00	6.00	5.00	4.50	4 00	6.00	3.50
" " 8 " 14 " 50 "	6.00	5.90	8.00	4.50	9.00	6.00	4.25	6.00	6.50	5.00	.10	7.00	6.00	5.00	6.00	5.25	6.00	5.50
" " 14 " 20 " 10 "	7.00	10.00	10.00	4.50	12.00	8.00	5.00	6.00	8.00	6.00	.10	10.00	7.00	5.00	8.00	6.50	4.00	7.00
Brick masonry, 240 cu. yds.	6.00	4.20	5.00	4.50	5.50	5.50	5.00	6.00	5.00	6.00	4.75	6.00	6.00	5.50	5 60	5.75	8.00	5.00
Concrete masonry, 200 cu. yds.	4.00	1.75	3.50	4.00	2.00	5.00	5.50	4.00	5.00	5.00	4.15	3.00	5.50	5.00	4.50	3.75	4.50	2.50
Rubble stone masonry, 10 cu. yds	5.00	2.00	3.50	3.00	4.00	6.00	6.00	4.00	4.00	5.00	6.00	4.00	6.00	3.00	6.00	7.00	7.00	2.50
Pipe sewer, 8 to 12-in., 9,810 lin. ft.	.10	.09	.10	.10	.10	.15	.09	.05	.10	.15	.12	.10	.17	.10	.12	.08	.15	.18
" " 15 " 18 " 4,190 "	.15	.13	.15	.15	.20	.20	.15	.12	.13	.20	.19	.10	.19	.18	.25	.12	.25	.20
Pipe chimneys, 800 "	.10	.09	.10	.05	.05	.10	.04	.04	.08	.10	.05	.05	.15	.10	.06	.10	.05	.10
Sub-drain pipe laid, 6,000 "	.15	.18	.25	.18	.30	.20	.20	.17	.20	.50	.15	.15	.40	.20	.22	.19	.20	.22
Spruce lumber in place, 2 M. ft. B. M.	40.00	22.00	30.00	50.00	40.00	40.00	35.00	35.00	30.00	35.00	40.00	35.00	30.00	38.00	35.00	40.00	30.00	25.00
Spruce piles driven, 200 lin. ft.	.30	.25	.35	.25	.40	.40	.30	.35	.60	.80	.25	.50	1.00	.30	30	.30	.50	.14
Total amounts	$19,842	$12,376	$21,178	$17,260	$21,656	$18,472	$18,676	$17,916	$18,288	$23,294	$22,524	$19,188	$24,870	$21,228	$21,398	$16,809	$23,714	$12,876
Total bids received for portions of Sections 7 and 8.	20,757	14,282	20,677	17,889	22,822	17,812	19,049	19,379	19,690	22,698	19,065	22,577	24,923	21,340	21,867	18,459	24,194	14,576

PIPE, HYDRANTS, ETC.—St. Paul, Minn.—Contracts have been awarded by the water commissioners as follows: Harrison & Howard Iron Co., Bessemer, Ala., cast iron pipe, at $18.74 per ton, f. o. b. cars in St. Paul; South Park Foundry & Machine Co., special castings, at 2¼ cts. per lb.; Northwestern Wheel & Foundry Co., St. Paul, fire hydrants, at $34 each; St. Paul Foundry Co., stand-pipes and manhole covers, at $10.50 and $10 each; Nick Feyen, drayage, 57 cts. per ton.

SEWERS.—Brockton, Mass.—The contract for constructing section 8 of the sewerage system was awarded to the National Construction Co., Boston, at $23,319, as stated in our issue of April 19. F. Herbert Snow, Cy. Engr., informs us that the bids were as follows, 1 being based on the retention in the contract of a clause compelling the employment of Brockton laborers only and at the rate of $2 per day of nine hours, and 2 being for a contract without this clause. The bids show an increase of from 15% to 62% for city labor over the price bid for contract labor, the average increase of all the bids being 28%:

Bids Received for Constructing Section 8 of the Sewerage System, Brockton, Mass.

		National Const'n Co.		Lucian A. Taylor.		Joseph Long.		Mel'p'n Const'n Co.		Andrew W. Bryne.		Dennis O'Connell.		Charles McDermott.	
		1	2	1	2	1	2	1	2	1	2	1	2	1	2
Excav.,	0 to 9 ft., 16,580 cu. yds.	$0.69	$0.53	$0.84	$0.68	$0.80	$0.65	$1.05	$0.90	$1.20	$0.80	$1.00	$0.80	$1.00	$0.80
"	9 to 15 ft., 3,833 cu. yds.	1.33	1.00	1.15	.95	1.25	1.00	1.05	.90	1.40	.85	1.50	1.10	1.50	1.10
"	15 " 21 " 730 "	1.66	1.25	1.45	1.15	2.50	2.20	1.05	.90	1.60	.90	2.00	1 60	2.25	1.50
"	21 " 25 " 20 "	1.86	1.40	1.90	1.50	3.00	2.70	1.05	.90	2.00	1.20	2.50	2.00	2.75	2.00
Brick masonry, 380 cu. yds.		12.00	12.00	12.50	12.00	11.75	11.75	10.65	10.65	20.00	12.00	12.00	11.70	15.25	15.25
Concrete masonry, 100 cu. yds.		5.00	5.00	2.75	2.50	5.00	5.00	5.25	4.50	6.00	5.00	6.00	5.00	8.00	8.00
Rubble masonry, 20 cu. yds.		3.00	3.00	3.00	2.70	5.00	5.00	6.65	5.75	8.00	6.00	6.00	5.00	8.00	8.00
Laying pipe sewer, 13,633 lin. ft.		.13	.13	.08	.07	.14	.10	.11	.09	.25	.12	.20	.14	.25	.20
"	subdrain, 15,423 lin. ft.	.15	.15	.18	.14	.25	.20	.19	.15	.70	.40	.50	.35	.85	.60
"	chimneys, 450 lin. ft.	.30	.30	.08	.08	.11	.10	.05	.05	.20	.10	.10	.06	.30	.20
"	iron pipe, 24 lin. ft.	.30	.30	.25	.20	.30	.30	1.00	1.00	2.00	1 00	3.00	5.00	.50	.50
Lumber in place, 10 M. ft.		40.00	40.00	40.00	35.00	35.00	35.00	40.00	40.00	50 00	40.00	40.00	35.00	30.00	30.00
Amount of bid, (1) city labor.		$27,535		$28,826		$31,172		$31,804		$49,675		$40,078		$47,747	
Amt. of bid, (2) contract labor.		$23,309		$24,154		$26,185		$27,647		$30,658		$31,493		$37,753	

ASPHALT PAVING.—Fort Wayne, Ind.—The lowest bid for paving West Washington St. with asphalt was that of the Barber Asphalt Paving Co., at $2.77 per sq. yd. If this bid is accepted press reports state that the company will erect a $10,000 plant in this city.

PAVING MATERIALS.—Worcester, Mass.—The committee on highways has received the following bids for paving materials: Samuel Fowler, Northbridge, curbstone, 43 cts. per lin. ft.; 18-in. flagstone, 43 cts. per lin. ft.; 24-in., 63 cts.; circular curb, 63 cts. per lin. ft.; block paving, $1.50 per sq. yd.; large corners, $3.75 each; small corners, $2.75 each; Wm. Reed & Co., Graniteville, Mass., 45 cts., 40 cts., 70 cts., 75 cts., $1.69, $4 and $3, respectively; Webb Granite & Construction Co., 43 cts., 40 cts., 60 cts., 60 cts., $1.60, $4 and $3 (recommended for acceptance); Kenneth McKay, Valley Falls, block paving, $1.40 per sq. yd.; Quincy Granite Co., $1.40 per sq. yd.

LAYING STREET PAVING.—Worcester, Mass.—The "Spy" states that the committee on highways will recommend the awarding of the contract for laying street paving for the coming season to C. O. Richardson at the following prices: Brick paving, 20 cts. per sq. yd.; brick on edge, 25 cts.; gutter and crosswalks, 22 cts.; curbstone, 8 cts. per lin. ft.; circle curb, 15 cts.; flagstone, 10 cts.; block paving, 25 cts. per sq. yd.; corners, 50 cts.

BRICK PAVING.—Bellevue, Pa.—J. M. Simeral, Secy. Council, writes us that the contract for paving Lincoln Ave., with one layer of brick has been awarded to McCready & Rosser, Braddock, at the following prices: Paving, $1.35 per sq. yd.; grading, 21 cts. per sq yd.; curbing, dressed, 60 cts. per. lin. ft., and rough, 30 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.15 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.35 to 1.4 cts. for shell, 1.55 to 1.6 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.2 to 1.25 cts.; channels, 1.2 to 1.25 cts.; angles, 1.1 to 1.2 cts.; tees, 1.25 to 1.35 cts.; universal mill plates, 1.1 to 1.2 cts.; steel plates, 1.15 to 1.25 cts. for tank, 1.3 to 1.35 cts. for shell, 1.4 to 1.45 cts. for flange, 1.75 to 4 cts. for firebox. Chicago: beams, 1.35 to 1.4 cts.; channels, 1.35 to 1.4 cts.; angles, 1.3 to 1.4 cts.; tees, 1.5 to 1.6 cts.; universal plates, 1.3 to 1.35 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.5 to 1.6 cts. for shell, 1.6 to 2.1 cts. for flange, 2 to 5 cts. for firebox.

INDUSTRIAL NOTES.

THE HALL SIGNAL CO., of New York, N. Y., has a contract to equip the section of the Philadelphia & Reading R. R. between Philadelphia and Jenkinstown with its automatic electric signals, the normal position to be at danger.

THE RHODE ISLAND LOCOMOTIVE WORKS, of Providence, R. I., have delivered five compound engines to the Lake St. Elevated R. R., of Chicago, and will deliver five more in a few weeks. They are duplicates of the engines built for the company when the railway was first started.

THE YOUNGSTOWN BRIDGE CO., Youngstown, O., is building four spans for the Richmond & Danville R. R., and has also been awarded the contract for the State Exposition buildings at Springfield, Ill., and the new Lyceum Theatre at Memphis, Tenn.

H. K. PORTER & CO., Pittsburg, Pa., builders of light locomotives, report orders on hand for some steel works locomotives, a small mine locomotive for the Pacific Coast, a heavy mogul engine and a saddle tank engine for logging roads, also some plantation engines and a small extra narrow gage engine for Brazil.

BROWNELL & CO., of Dayton, O., manufacturers of boilers, engines, etc., have added to their boiler equipment a 20-ft. pair of extra long steam driven plate bending rolls, enabling it to make boilers 20 ft. long in two sheets. They have shipped a stand-pipe, 20 x 100 ft., to Paris, Ill., and have a contract for one, 16 x 125 ft., for Warrensburg, Mo. The company reports a growing business and works running full time. It has purchased the entire plant of the Sioux City Engine Works and will remove it to Dayton.

METAL MARKET PRICES.

LEAD.—New York: 3.4 to 3.42 cts. Chicago: 3.3 cts. St. Louis: 3.2 cts.

NAILS.—Pittsburg: 95 cts. to $1 for wire, and $5 to 90 cts. for cut at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $13.50. Pittsburg: $10 to $11.50. Chicago: $10 to $11.50.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.5 to 1.75 cts.; track bolts, 2 to 2.1 cts. with square and 2.15 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.25 to 1.4 cts.; spikes, 1.7 to 1.8 cts.; track bolts, 2.3 to 2.35 cts. with hexagon nuts.

RAILS.—New York: $24.00 at eastern mills and at tidewater; old rails, $11 for iron, and $9 for steel; light rails, $22 to $24; girder rails, $20.50 to $22. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $10.50 for iron and $9.50 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.3 to 1.5 cts.; angles, 1.2 to 1.35

NEW COMPANIES.—St. Louis Electric Brake Co., East St. Louis, Ill.; $2,000,000; J. L. Black, Samuel Resh and W. V. Wolcott.——Milwaukee Steam Pump & Purifier Co., Milwaukee, Wis.; $50,000; Geo. F. Lynch, G. G. Husely and E. A. Gles.——Chicago Bituminous Rock Co., Chicago, Ill.; $300,000; J. P. Malette, G. P. Everhart and Hiram T. Gilbert.——Florida Engineering & Construction Co., Chicago, Ill.; $150,000; D. S. Ryan, Albert T. Otto and Morgan Cowan.——Florida Engineering Co., Kingsford, Fla.; $75,000; Louis McLain, Sanford, Fla.; J. K. Miner, Pemberton, Fla., and W. B. W. Howe, Jr., Charleston, S. C.——Elliott Air Brake Co., Philadelphia, Pa.; $5,000,000; incorporated in West Virginia.——Geneva Construction Co., Trenton, N. J.; $20,000; J. B. Reilly, of Trenton, and John T. Dolan, of New York.——Kittanning Brick & Fire Clay Co., Kittanning, Pa.; $30,000; Treas., S. C. Martin, Pittsburg, Pa.——Sumner Brick & Tile Co., Sharpsburg, Pa.; $5,000; Treas., H. Robinson.——New Lisbon & Manahawkin Short Line Construction Co., Camden, N. J.; $50,000; D. E. Culver, 45 Montgomery St., Jersey City, N. J.; B. Wright, 38 Park Row, New York.——Strait Smith Co., Bayonne, N. J.; $25,000; Emmett Smith.——Pennsylvania Brick Mfg. Co., Philadelphia, Pa.; $50,000; Treas., A. G. Clay.——Glazier Headlight Co., Rochester, N. Y.; $6,000; Elias C. Glazier and W. H. Elliott, New York.——Santo Domingo Central Construction Co., Jersey City, N. J.; $200,000; C. A. Burbank and J. L. Delafield, New York.——Dewey Electric Signal Co., Jersey City, N. J.; $60,000; A. M. Dodge, New York; F. G. Ingersoll, New Haven, Conn.

ADVERTISEMENT.

DOLGEVILLE, N. Y., WATER-WORKS.

NOTICE TO CONTRACTORS.

Notice is hereby given that proposals will be received by the Board of Water Commissioners of the village of Dolgeville, N. Y., until 12 o'clock noon on the 25th day of May, 1894, for the construction of a gravity system of Water Works.

Proposals will be received for "The Works' complete, or for furnishing materials and performing work under the following subdivisions:

1. Furnishing pipe and special castings.
2. Furnishing valves, valve-boxes and covers, and hydrants.
3. Trenching, pipelaying and backfilling.
4. The Reservoir.

The whole of the work must be completed on or before the 1st day of December, 1894.

The Board of Water Commissioners reserves the right to reject any and all bids.

Plans for the foregoing work may be seen and examined at the office of the Board of Water Commissioners in the village of Dolgeville, N. Y. Blank forms of proposal and contract, together with specifications, will be furnished upon application to W. H. Bacon, Secretary of the Board of Water Commissioners.

ALFRED DOLGE,
President of the Board of Water Com-
19-1t missioners.
Dolgeville, N. Y., May 1, 1894.

PROPOSALS FOR SEWER MATERIALS.

NOTICE TO CONTRACTORS.

VILLAGE OF BRUNSWICK, ME.

Sealed proposals for furnishing Brick, Cement, Vitrified Sewer Pipe, Cast-iron Pipe and Manhole Castings, will be received by the Sewer Committee of Brunswick Village Corporation, of Brunswick, Me., at the Assessor's office in said village until 12 M. of Thursday, May 17, 1894.

The award of the contracts, if awarded, will be made as soon thereafter as practicable. Specifications for the furnishing of the above materials can be seen at the office of Ernest W. Bowditch, 60 Devonshire street, Boston, Mass.

All proposals must be made upon blank forms furnished by said village corporation, and must be accompanied by a certified check for the following amounts:

With bid on brick	$200
" " " cement	100
" " " vitrified sewer pipe	200
" " " cast-iron pipe	25
" " " manhole castings	150

The quantities required are approximately as follows:

Brick, 200,000.

Cement: 450 bbls. Rosendale; 100 bbls. Portland.

Vitrified Sewer Pipe:

12,500 ft. 6" pipe, including branches.
4,000 " 8" " " "
3,700 " 10" " " "
2,800 " 12" " " "
5,800 " 18" " " "

Cast-Iron Pipe:

36 ft. of 18"
48 " " 8"

Manhole Castings, 120 sets of frames and covers.

The Sewer Committee reserves the right to reject any or all bids.

ERNEST W. BOWDITCH,
18-2t Chief Engineer.

NOTICE TO SEWER CONTRACTORS.

BRUNSWICK VILLAGE CORPORATION, MAINE.

Sealed Proposals for building about five and six-one hundredths miles of pipe sewers will be received by the Sewer Committee of Brunswick Village Corporation, Maine, at the Assessor's Office in said Village until 12 (M.) of Thursday, May 17th, 1894.

The award of the contract, if awarded, will be made as soon thereafter as practicable.

All Proposals must be on blank forms furnished by said Village Corporation, and must be accompanied by a certified check for $1,000, drawn on some National Bank, and made payable to the Treasurer of Brunswick Village Corporation.

Some of the approximate quantities are as follows:

13,000 linear feet of 6" sewer.
4,300 " " " 8" "
3,700 " " " 10" "
2,800 " " " 12" "
5,900 " " " 18" "

400 cubic yards of brick masonry in manholes.

36,000 cubic yards of excavation at various depths.

Bricks, pipe, cement, and iron castings will be furnished by the village. Plans can be seen, and specifications, forms of contracts, and proposals obtained, at the office of Ernest W. Bowditch, 60 Devonshire street, Boston, Mass. The Sewer Committee reserves the right to reject any or all bids.

ERNEST W. BOWDITCH,
18-2t Chief Engineer.

PROPOSALS FOR STEAM PLANT.

Proposals are wanted for installing an 80 HP. Compound Engine, with boiler, pump, heater and extractor and all connections complete. Apply for particulars to

W. A. GUTHRIE,
Secretary of Electric Light Company,
19-1t San Angelo, Tex.

Notice to Bridge Builders and Contractors.

A civil engineer, graduate of the Troy Polytechnic, with fifteen years' experience in construction, desires to meet right party to enter into partnership for contract work. Has had extensive experience in deep foundations of various kinds, including the sinking of ten caissons, cofferdams, water-works, sewers, tunnels, railroad work, etc. Has extensive acquaintance with engineers. Desires to furnish part of the capital.

Address CONTRACTING ENGINEER,
17-tf Engineering News.

UTICA PIPE FOUNDRY CO.

CAST IRON PIPE AND SPECIALS FOR WATER AND GAS.

Also flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc. CHAS. MILLAR & SON, Selling Agents, Utica., N. Y. Manufacturers of Lead Pipe and Plumbers' Materials. Wholesale Eastern Agents Akron Vitrified Sewer Pipe.

FOR Best Results USE THE WARREN FILTER,

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COLUMBUS SEWER PIPE Co. COLUMBUS, OHIO.

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Smoothness of motion, absolute safety and high speed are among the good qualities possessed by

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MANUFACTURERS OF

Boiler Tubes, Wrought Iron Pipe and Fittings.

Electric Railway and Light, Pipe a Specialty.

CITY OF PITTSFIELD.

NOTICE TO CONTRACTORS.

Sealed proposals for constructing about two and one-half (2½) miles of pipe sewers, in the city of Pittsfield, in the Commonwealth of Massachusetts, will be received by the Board of Commissioners of Sewers of said city, at their office in said city until 12 (noon) of Monday, May 14, 1894, when they will be opened and read in the presence of the competitors All proposals must be on the blank form furnished by said Board, and must be accompanied by a certified check payable to the said city for five hundred dollars. Pipe, brick, cement, iron pipe and iron manhole castings will be furnished by said city. Plans and profiles can be seen, and the specifications and form of contract obtained at the above office. No bid will be received in case the bidder has not looked the work over on the ground. Said Board reserves the right to reject any and all bids.

JOHN H. MANNING,
CHARLES W. KELLOGG,
JAMES L BACON,
Board of Commissioners of Sewers of the City of Pittsfield.
ERNEST W. BOWDITCH,
18-2t Engineer.

TREASURY DEPARTMENT, OFFICE SUPERVISING Architect, Washington, D. C., April 30, 1894.—Sealed proposals will be received at this office until 2 o'clock P. M. on the 23d day of May, 1894, and opened immediately thereafter, for all the labor and materials required for the excavation, foundations, basement and area walls, basement columns and I-beams, etc., of first floor construction, temporary drainage, etc., for the U. S. Court House, Post Office, etc., at Savannah, Georgia, in accordance with the drawings and specification, copies of which may be had at this office or the office of the Superintendent at Savannah, Georgia. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any and all bids or to waive any defect or informality in any bid should it be deemed in the interest of the Government to do so. All proposals received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes, sealed and marked. "Proposal for Excavation, Foundations, Basement and Area Walls, Iron Floor Construction, etc., for the U. S. Court House, Post Office, etc., at Savannah, Georgia," and addressed to JEREMIAH O'ROURKE, Supervising Architect. 18 2t

CITY OF PITTSFIELD.

Sealed proposals for the furnishing of any of the following materials will be received by the Board of Commissioners of Sewers of the City of Pittsfield, Mass., up to hour of 12 (noon) on the fourteenth day of May, 1894, at the City Hall of Pittsfield, at which time and place all persons competing are invited to be present. The proposals will then be opened and read and no proposals will be received after that time, except upon the rejection of all proposals then presented.

Specifications for the furnishing of materials can be seen at the office of Ernest W. Bowditch, 60 Devonshire Street, Boston, Mass., and at the office of the Board of Sewer Commissioners of the City of Pittsfield, Mass.

All proposals must be on the blank forms furnished by the said Board and must be accompanied by a certified check for one hundred dollars on bid for brick, fifty dollars on bid for cement, fifty dollars on bid for manhole castings, and one hundred dollars for bid for vitrified pipe. Approximate quantities required:

Hard-burned brick, 100,000.
Cast Iron Manhole Covers and Rims, 40.
Rosendale Cement, 350 bbls.
Portland Cement, 100 bbls.
Vitrified Pipe (Akron or its equivalent):
6-inch and branches, 6,000 feet.
8-inch " " 1,800 "
10 inch " " 1,200 "
18-inch " " 3,500 "

The right is reserved to reject any and all bids, should it be deemed for the interest of the City of Pittsfield to do so.

JOHN H. MANNING,
JAMES L. BACON,
CHARLES W. KELLOGG,
Board of Commissioners of Sewers of the City of Pittsfield.
ERNEST W. BOWDITCH,
18-2t Engineer.

TO BRIDGE CONTRACTORS.

State of Georgia, County of Pulaski, }
Court of Ordinary, Hawkinsville, Ga., }
April 28, 1894. }

Bids, plans and specifications are solicited for placing two (2) sixty-feet iron spans in place of the present wooden approaches to the drawbridge across the Ocmulgee River in said county. I will pass upon all bids, etc., that may be sent in at twelve o'clock noon on Wednesday, the 13th day of June, 1894, at my office in Hawkinsville, Ga. The right to reject any and all plans and bids is reserved. For further information apply to

P. T. McGIFF,
18-6t Ordinary, Pulaski Co.

SPRINGFIELD WATER-WORKS.

NOTICE TO CONTRACTORS.

Sealed proposals will be received by the Trustees of Water-Works of the city of Springfield, O., at their office in said city, until 12 o'clock noon of Thursday the 24th day of May, 1894, as follows:

For furnishing approximately 12,500 lineal feet, 1,708 net tons, of 24-inch cast iron pipe, and approximately three tons of ordinary special castings, together with the necessary flanged pipe and specials for pump connections as may be required and shown by detail drawings. Also for trenching and laying said pipe and special castings.

Also one Pumping Engine, capable of pumping ten (10) million gallons of water per twenty-four hours to an altitude of 250 feet into a standpipe 30 feet in diameter; also foundations for said machinery.

Also a boiler plant with easy capacity to furnish one and one-half times the power requisite for the propulsion of said machinery when working to its maximum capacity. Also for live steam Feed Water Purifier for entire boiler plant, with extra set of pans for same. Also foundations and settings for said boilers.

Also for two or more 24-inch valves.

Also for one iron or steel bridge, 100 feet clear span, with 16 feet roadway, capable of sustaining a moving load of 100 pounds per square foot of floor area, with safety factor of five. Also two stone abutments under said bridge.

Specifications, forms of proposal and forms of contract will be furnished from and after May 18, 1894, from and after which date also the necessary general and detail drawings will be ready for the examination of bidders.

The Trustees expressly reserve the right to accept such bids for machinery and boilers as in their judgment will best subserve the interests of the city; and to that end the right is hereby expressly reserved to carefully examine, determine and be governed by the measure of economy in current performance of machinery and boilers offered, their probable immunity from breakage or imperfect action; also as to perfection and particular mechanical design, and also as to the satisfactory antecedent and present performance o similar or identical machinery and boilers in actual service elsewhere.

Subject to the express right to reject any or all bids.

E. C. GWYN, President,
C. NAGLE,
CHAS. A. BAUER,
Trustees.
J. D. COOK, Toledo, O.,
Consulting Engineer.
Springfield, O., May 2, 1894. 19-2t

TO WATER-WORKS CONTRACTORS.

Sealed proposals will be received at the office of the Water-Works Trustees of the City of Steubenville, Ohio, until 12 o'clock noon, May 24, 1894, for furnishing all material and performing all labor necessary for the construction of a new water-works plant for the above city.

The work to be done embraces the following:

Part 1.—Furnishing Cast Iron Pipe.
" 2.— " Valves and Fire Hydrants.
Part 3.—Hauling and Laying Pipes and Valves.
Part 4.—Constructing Reservoir.
" 5.— " Pump Well and Tunnel.
Part 6.—Constructing Wet Well and Influent Pipes.
Part 7.—Furnishing Two 3,000,000 Gallon Pumping Engines.
Part 8.—Furnishing Boiler Plant.
" 9.—Constructing Boiler and Engine House.

The Water-Works Trustees reserve the right to reject any and all bids.

Plans and specifications can be seen and forms of proposals secured at the Council Chamber, Steubenville, or at the office of the Engineers, Westinghouse Building, Pittsburgh, Pa., after May 10, 1894.

By order
Water-Works Trustees.
WILKINS & DAVISON,
19-2t Engineers.

STANDARD RESERVOIR AND TIDE GAUGE.

FOR USE ON RESERVOIRS, HARBORS, RIVERS, IRRIGATION CANALS, ETC.

The apparatus is small, compact, simple in adjustment, easily set up. It plots automatically a continuous curve for one month, one week, or one day, as may be required. Has been used for several years on some of the Principal Reservoirs and Harbors of the United States and Mexico. Prices greatly reduced.

For circulars and information write to

STANDARD GAUGE CO., No. 24 Haven Bldg., Buffalo, N. Y.

SPIRAL WELD PIPE FOR SALE.

About 60,000 ft. of 8-in. New Spiral Weld Steel Pipe, including Couplers; 30 ft. lengths; number 16 gage; price, 35 cents per foot, f. o. b. Chicago; guaranteed pressure, 500 lb. per square inch. Address F. K. BOWES, 5 Grand Pacific Exchange, Chicago. 19-1t

For Other Proposals see Page XXI.

THE "EUREKA" STREET SWEEPER.

We *have* found it! Those having experience in street cleaning, and having practically tested street cleaning machines of every make, agree that our improved 'Eureka" Street Sweeper excels all others, and possesses all essential qualities of a *perfect* street cleaning machine, as witness the following:

THE BOARD OF STREET AND WATER COMMISSIONERS.

Dear Sirs: *Newark, N. J., Feb.* 23, 1884.

We adopted your "Eureka" Street Sweeper after a fair trial of all the improved machines in the market, and found its advantages to be, first, ability to turn machine in its own length, without dragging the broom; second, lightness and durability; third, perfection with which it performs its work; fourth, simplicity and ease of handling by inexperienced men without getting out of order; fifth, low price of your machine. *Yours, etc.,*

CHARLES MARSH, Gen. Supt. of Works.

TWO-HORSE IMPROVED "EUREKA" STREET SWEEPER.

We can deliver these machines in three days from receipt of order.

Our patent box hub encloses the axle and effectually protects all working parts from dust and dirt, preventing clogging and insuring constant free working; while our patent triple ratchet holds the axle always in the direct centre and prevents wabbling and damage. Our sweeper, thus working free and steady, lasts longer, performs better work, in less time than other sweepers, and is less wearing upon horses. The "Eureka" makes "a clean sweep" wherever it goes, and cannot be excelled for quantity and quality of work. It is made of the very best material, and though its construction is perfect and complete, it is yet so simple that inexperienced hands can operate it successfully from the start without damage to any part; it simply being required that the oil wells be filled once a week.

Having superior facilities for manufacturing, we are enabled to produce at a minimum cost that which we claim the 'Eureka" to be, as a street cleaning machine—the maximum of quality, durability and effectiveness

Correspondence solicited. Information promptly furnished and prices quoted on application Address

THE LEWIS & FOWLER M'F'G CO.,

SOLE MANUFACTURERS,

OFFICE, 28 SANFORD STREET, BROOKLYN, N. Y.

Also Manufacturers of Electric Snow Sweepers and Cars for Street Railways.